Emerging Stronger

Lasting Impact from Crisis Innovation

Edited by
Beverley Gibbs & **Gary C Wood**

Engineering Professors
COUNCIL
The voice of engineering academics

Emerging Stronger

Lasting Impact from Crisis Innovation

Engineering Professors
COUNCIL
The voice of engineering academics

To cite this publication:

Gibbs, B. & Wood, G. C., eds. (2020). *Emerging Stronger: Lasting Impact from Crisis Innovation.* Godalming: Engineering Professors' Council.

For chapters:

Author(s). (2020). Chapter Title. *In*: Gibbs, B. & Wood, G. C., eds. *Emerging Stronger: Lasting Impact from Crisis Innovation.* Godalming: Engineering Professors' Council.

Contents

Author Profiles

Steve Cayzer

Dr Steve Cayzer is a Senior Lecturer at the University of Bath where he designs and leads interdisciplinary programmes in Engineering Management. He champions active learning approaches that foster student agency, peer learning and collaboration on meaningful challenges. He enjoys working with students and colleagues to develop research-informed best practices in teaching, and to share these practices across the sector and beyond. Examples of these innovations include the use of Team Based Learning (TBL), Massive Open Online Courses (MOOCS), team profiling, social network analysis and gamification, all of which have been addressed in his pedagogical research. He won the University award for Innovation in Learning & Teaching in 2019 for his contributions.

Before joining Bath, Steve worked in the IT industry for 15 years in both consultancy and research roles. *https://researchportal.bath.ac.uk/en/persons/steve-cayzer*

Beverley Gibbs

Beverley Gibbs is Professor of Engineering Education and Chief Academic Officer at the New Model Institute for Technology and Engineering (NMITE), an initiative that aims to be an influence for disruptive innovation in engineering education. Until recently she was Director of Learning and Teaching (Strategy) in the Department of Mechanical Engineering at the

University of Sheffield, leading curriculum, pedagogy, accreditation and employability outcomes for 900 undergraduate and postgraduate students. For her work in curriculum transformation, she was awarded the University's 2019 Senate Award for Leadership in Learning and Teaching. In her own practice, Beverley is an advocate for student partnerships in curriculum design, and in learning and teaching environments that support the development and empowerment of each individual student, even (or especially!) at scale.

Before entering academia, Beverley worked for 20 years in manufacturing, mining and associated industries, in engineering, research and commercial leadership roles.

www.linkedin.com/in/bevgibbs

John Mitchell

John E Mitchell is Professor of Communications Systems Engineering in the UCL Department of Electronic and Electrical Engineering, Vice-Dean Education in the UCL Faculty of Engineering Sciences, and Co-director of the UCL Centre for Engineering Education. Between 2012 and 2016, he was on secondment to the UCL Engineering Sciences Faculty Office, where he led the introduction of the Integrated Engineering Programme. The team that led this major revision of the curriculum across the engineering faculty has recently been awarded the HEA Collaborative Award for Teaching Excellence (CATE). In 2009, he was awarded the UCL Provost's award for teaching and has published on curriculum development with engineering education. Professor Mitchell is a Chartered Engineer, Fellow of the Institution of Engineering and Technology (IET) a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE), Member of the Board of Directors of the European Society for Engineering Education and Principal Fellow of the Higher

Education Academy. He is currently Editor-in-Chief of the IEEE Transactions on Education.
www.ucl.ac.uk/centre-for-engineering-education

Gary C Wood

Dr Gary C Wood is a National Teaching Fellow, and experienced educator, recognised for developing and delivering innovative learning experiences that challenge students to build technical knowledge whilst enhancing professional skills. He has particular expertise in creating and using integrative projects for authentic learning; building inclusive communities of learning; and supporting students' transition into and out of higher education. He also has strong interests in student engagement in curriculum design, and enhancing learning with technology.

After teaching linguistics for eight years, he moved into education and academic development in 2014, working with engineers to develop effective, authentic learning experiences, and supporting colleagues to enhance their teaching practice. He is currently University Teacher in Professional Skills in the Department of Mechanical Engineering, at the University of Sheffield, and Head of Sheffield Engineering Leadership Academy, which he co-founded in 2014. SELA is a unique, co-curricular programme working in partnership with industry to fast-track the development of undergraduate engineers into leaders with the skills, confidence and aptitude to make a positive difference. In Mechanical Engineering, Gary is leading the design and integration of a spine of professional skills development throughout the Department's degree programmes, to equip its students and graduates with capabilities to succeed in their studies and professional lives.
www.garycwood.uk

Foreword

As engineers, our impact is greatest when we work together to design effective solutions. A striking example of this is the response of the UK academic engineering community to the COVID-19 pandemic. This has accelerated the transformation of engineering education – removing barriers to innovation as well as introducing new challenges. With almost no lead time education delivery and assessment was pivoted at pace to online delivery.

The insights and experiences of all those forging the new approaches – as well as those of the students whose formation as professional engineers they enable – are welcomed by the Engineering Professors' Council and the UK academic engineering community which it represents. We warmly welcome the emerging innovations and ideas shared in Emerging Stronger: Lasting Impact from Crisis Innovation. This 'snapshot' taken in May/June 2020 provides the community with a resource as the sector plans and prepares for the start of the 2020/21 academic year. We hope that this work provides inspiration and guidance, gives confidence, stimulates discussion and further strengthens the academic engineering community – as we work together in producing innovative, effective solutions with lasting impact.

Mike Sutcliffe
Vice President
Engineering Professors' Council

Editors' Introduction

At the start of 2020, no-one could have known what major changes lay just three months ahead for higher education – indeed, for our very way of life. Yet here we are, in the middle of the year, living through a pandemic, and in the midst of one of the most significant, challenging, and disruptive periods imaginable.

Less than a year earlier, we had established *Pioneering Programmes and Practice in Engineering Education*, a network of engineering educators, on the Advance HE Connect platform.[1] Our vision was to bring together engineering educators to support and promote innovation and ambition in programme design and classroom practice, although none of us recognised at that time the scale and scope at which this would need to happen within the year.

As the pandemic hit, we witnessed innovation, adaptation, change, and resilience in colleagues and students of unprecedented scope, on an unprecedented scale, and at unprecedented speed. Almost overnight, physical campuses closed, lectures were replaced by livestreams, and groupwork went global as students returned to their families. Laboratory and practical classes were reimagined and replaced. Assessment plans were torn up, with student bedrooms becoming our new exam halls. Placements, internships and extra-curricular activities all but disappeared. And yet, amidst this potential chaos, students and staff worked together – in unconscious partnership – to find solutions, and keep learning from and with each other, like never before.

From the beginning, what was striking about these changes was the apparent loss of perceived barriers that had previously hindered innovation. COVID-19 provided a new freedom for educators to try new ideas and do things differently, and a catalyst for everyone to do so: the status quo no longer existed to be maintained.

An obvious question quickly arose: what value might there be in the longer term retention of some of these new approaches, beyond the immediate crisis? Even without formal evaluation, some benefits seemed immediately apparent. For example, open-book assessment prompted a shift to more authentic

---

[1] https://connect.advance-he.ac.uk

questions of application rather than simple recall of knowledge; digital delivery of lectures enabled students to choose the pace and place of their learning with greater flexibility; and students' employability was enhanced through developing skills in collaboration across space and time. There were, of course, challenges, too: How do we develop practical skills in students at a distance? How can students gain workplace experience in the absence of internships? How do we maintain academic standards in remote assessments?

To explore questions such as these, we launched, through *Pioneering Programmes and Practice in Engineering Education*, a series of webinars entitled: *Engineering Education: Lasting Impact from Crisis Innovation*.[2,3] Across six weeks, we brought together over 250 educators and practitioners, to share ideas and discover emerging innovations. We explored assessment; collaboration and professional skills; remote laboratory work and practical skill development; employability; and student partnership in learning design. In the sixth week, eight invited contributions from across the sector showcased emerging good practice.

The success of the webinar series genuinely took us by surprise. We were encouraged to see so many positive innovations, and the creativity of our community in keeping the show on the road, with determination to deliver positive learning outcomes for students. The present volume emerges from and celebrates this work, sharing the thinking and discussion that we explored together. It is organised into two parts.

Part 1 consists of five chapters. The first three chapters explore issues at the forefront of most educators' minds in the early weeks of disruption: assessment (chapter 1), student collaboration and professional skills (chapter 2), and remote laboratory and practical work (chapter 3). The final two chapters explore the disruption's effects on agendas of growing importance in the sector: what the changes mean for the employability of students (chapter 4), and how students have been, and can continue to be, engaged as partners in learning design (chapter 5). Each chapter sets out the context and importance of its topic in engineering education, before sharing network activity from the webinars, and presenting case studies of emerging good practice from colleagues across the sector.

Part 2 shares students' experiences of their new ways of learning, in their own words. These perspectives were solicited from students through an open call, widely promoted through social media and through webinar participants.

---

[2] www.garycwood.uk/2020/05/lasting-impact-from-crisis-innovation.html
[3] Materials and all resources from these webinars can be viewed on the Advance HE Connect platform (see footnote 1).

Many of these submissions speak to multiple themes of the webinars, hence our decision to present them separately in their own part of this publication, rather than including them in specific chapters. However, each chapter in Part 1 cross-references relevant student voices, to help the reader find utility in them.

We wish to thank all students who shared their thinking with us for inclusion here, and in discussion during the webinars. We also express our gratitude to colleagues for contributions of case studies to this volume, and to the discussions and lively webinars that made it possible. In particular, we thank guest hosts Trevor Collins (Open University), Andrew Garrard (University of Sheffield), Kay Hack (Advance HE), and Mike Sutcliffe (TEDI-London) who joined and shared their expertise with us during the series. We appreciate the platform that Advance HE Connect offered us, so that we were in a position to move quickly when the crisis arose. Finally, we thank the Engineering Professors' Council, our publishers, for their support in enabling us to share this volume rapidly, so that it can become a community resource as engineering educators across the sector continue planning for the 2020-21 academic year.

We hope that this work will provide inspiration, guidance – indeed, reassurance – to colleagues as we now face the challenge, over summer 2020, of planning for the start of the new academic year with online or blended approaches to learning and teaching. We encourage you to capture your own stories of innovation, and to reflect on the benefits and challenges that arise. We further hope that we can capture the wider learning of our community, and more in-depth evaluation of approaches, in a follow-up volume in due course.

Gary C Wood & Beverley Gibbs
Sheffield, July 2020

Part 1

Challenges, Innovations & Emerging Good Practice

....

Chapter 1

What are we learning about assessment?

Beverley Gibbs
New Model Institute for Technology & Engineering

• •

This chapter takes assessment as its central focus, and in particular the disruption COVID-19 is posing to a common form of assessment in the sector: the invigilated, closed-book exam. Its call to action asks us to acknowledge the primacy of assessment alongside an acknowledged and persistent recognition that engineering graduates are not as work-ready as they could be, despite this being an aim of the accreditation process. Colleagues are invited to use COVID-19's disruption as a springboard to more diverse assessment methods that better support the development of graduates with the skills industry needs.

For good or bad, assessment lies at the heart of our work as educators. Marking and giving feedback constitutes a key part of our role. Assessment drives learning, giving students motivation, structure, milestones, and a basis for self-evaluation. And finally, assessment is the means by which students progress, and qualifications are awarded, through an evaluation of how well a student has achieved the intended learning outcomes of their course.

Without being particularly prescriptive, the UK's Quality Assurance Agency for Higher Education clearly outlines the features of effective assessment. It is aligned to learning outcomes and teaching activities; is reliable, consistent, fair and valid; holistic; inclusive; transparent; purposeful; timely; efficient; supportive, and facilitates academic integrity (QAA 2018:4-6). This is a wide set of expectations, and considerable critique is levelled at assessment profiles for so frequently falling short. One of the most prevalent critiques is from proponents of assessment-for-learning, who point to the central and profoundly influential effect of assessment on learning to promote authentic tasks and timely feedback (Boud & Falchikov 2007, Jisc 2018, William 2011).

The particular demands of accreditation add further depth to the role that assessment fulfills in an engineering programme. At the strategic level, assessment evaluates a student's fitness to enter the profession. However, this readiness for practice (or work-readiness) has been the subject of much concern by employers (Wakeham 2016, RAEng 2010, see also Chapter 4, this volume), leading to the obvious yet neglected question of whether assessment regimes are fit for this purpose. If the conclusion is that they are not, then the predictive validity of the assessments we are using is in serious doubt (Heywood 2016). Heywood expands this point through the observation that few engineering educators think seriously about the precise nature of the outcomes they are seeking to assess, and that in the 50 years since this was first noted, very little research has been published on this topic (ibid. p152). This lack of clarity and the skills shortage persist despite an outcomes-based accreditation process that aims to ensure students '..develop industry-ready skills' (Engineering Council 2014:3).

In the context of COVID-19, the Engineering Council has reiterated that it is not prescriptive of assessment modes (Engineering Council 2020). Despite this, closed book, invigilated examinations have remained prevalent across the sector. There are a number of important reasons that assessment has sometimes struggled to be as innovative as it could be. As Phil Race so succinctly puts it, '...one of the most significant problems with assessment is that just about all the people who do it have already had it done to them and survived the experience...' (Race 2020: 41). Also close to colleagues' minds will be workload, and the need to give high-quality feedback and transparently derived marks often to large, and increasingly diverse, cohorts of students.

Nevertheless, as campus buildings closed and students dispersed, alternative assessments to replace closed book exams became a common and urgent focal point. COVID-19 restrictions impacted the sector midway through a semester, when assessments had largely been set and students were working towards them. Much of our collective effort over recent months has been directed at reviewing assessments in order to adapt and derisk them for students and staff, whilst maintaining rigour, validity, and accreditation compliance. Some institutional leadership was bold: in a single policy decision, the University of London transitioned 500 exams in 160 countries from face-to-face to a digital formats, and the Open University cancelled all assignments unless they were required for regulation or part of a final assessment (Jisc 2020). Other universities have had more ground-up responses, inviting Departments, Schools and/or Faculties to manage alternative assessments.

Alternative approaches have been varied. Open book and take-home exams have been introduced, often for the first time, and many student

perspectives in Part 2 of this volume comment positively on that transition. Staff have embarked on the challenging process of learning how to write stretching questions that elicit evidence of a suitably advanced level of learning (Wood & Gibbs 2020), and students have been asked to learn how to digest, revise and respond to this type of question. Open book formats have not always been suitable, for example for colleagues testing analytical capabilities where collusion might be a risk. To counter this, use of exam windows has allowed students to take the exam at a time of their choosing within a 24 hour window, but with a submission time within, for example, 3 hours of download.

Other colleagues have taken advantage of the automated marking associated with online tests that include quizzes, multiple-choice and multiple-response formats, deployed in Virtual Learning Environments. Although online tests can often be poorly-designed and targeted at lower levels of learning, more thoughtful use and deployment can offer an assessment mode that is useful for students and staff, and efficient to administer (Boitshwarelo, Reedy & Billany 2017). In engineering, one of the case studies in this chapter (Stephen Beck, University of Sheffield), and a number of student perspective submissions (Part 2) have outlined the value in using online tests to specifically target threshold level knowledge that in and of itself can be considered to fulfil accreditation requirements, allowing a differently-targeted assessment to provide grade differentiation. This suggests that unpacking the multiple roles of assessment can lead to targeted efficiency and clarity for students, which may prove valuable in a near-future environment where we can expect our time to be stretched thinly.

A central question in designing alternative assessments was the concern that students might collude with one another, plagiarise or outsource assessment work, and their graded individual performance would not reflect their own individual work nor the individual competence required for accreditation. This concern arose in discussion with the *Pioneering Programmes and Practice in Engineering Education* network – evaluation and discussion within the community over Summer 2020 has the potential to tell us a great deal about the extent to which these considerations were warranted. Careful assessment design (for example through randomisation of questions within a cohort, or personalising questions by asking students to relate their answer to previous experience) can be powerful in making collusion less useful, as can deterrence through 'spot-check' moderation policies or ethical declarations (Wood & Gibbs 2020). Other colleagues have limited the time period in which a student can work on an assessment paper as previously mentioned. Imperial College's Thomas Lancaster adds that contract cheating offers are widespread, and an important part of student education is understanding the long term

risk (for example, from blackmail) that is involved in such 'services'; in this, he feels student partnerships have a powerful role to play in building networks of academic integrity (Lancaster 2020). What does not seem to have found a ready audience in these early days is the use of technology to fulfil invigilation duties: remote- or e-proctoring. This might include taking snapshots of students' work-in-progress, detecting unexpected sounds, or capturing unexpected network activity (Cormack 2020).

The rapid innovation in assessment described in this chapter has given many senior leaders and digital learning advocates confidence that this has been a step-change both in how we teach, and how we assess. The UK's digital infrastructure leader in higher education – Jisc – asked whether these '...radical and rapid changes [would progress a] long-awaited move to more authentic and adaptable assessment' (Jisc 2020). Provocateur for our first webinar on 19 May 2020 – Dr Kay Hack of Advance HE – took the opportunity to ask whether a reboot of assessment in engineering education was long overdue.

Network Activity

The *Lasting Impact from Crisis Innovation* webinar, *What are we learning about assessment?* elicited network participants' thinking about assessment in May 2020, at a time when many were in the midst of finding new assessment strategies for immediate implementation. The session was hosted by Dr Kay Hack, Academic Lead for STEM disciplines at Advance HE (Hack 2020).

In this, our first webinar in the series, we asked what was most on colleagues' minds that week: 43% were already preoccupied with what the socially-distanced campus might look like in 2020-21, 22% were most concerned with getting through the current assessment period, and 20% with supporting students. Other participants were concerned with recruitment and admissions, or personal issues such as job security or sleep. These responses provide an early indication that at the time of the webinar, two months on from the closure of campuses, good headway was being made in revising assessments, and thoughts were turning to longer-term solutions.

The central question Kay asked participants was whether – given the centrality of assessment outlined in the previous section – assessment was promoting the kinds of learning we want, and need. Drawing on data from the National Student Survey, Kay observed that we spend vast amounts of time and energy on assessment and feedback, yet this continues to be rated poorly by students. The 'Approaches to Studying Inventory' was introduced as a prompt to think about whether assessment was a barrier to learning
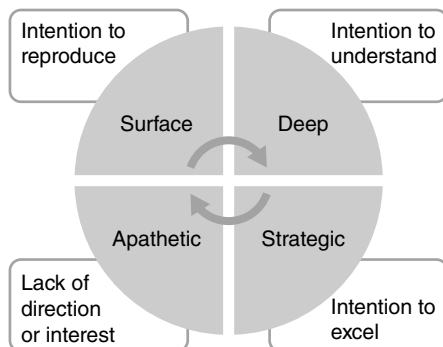
Figure 1.1: Approaches to Studying[1]

(Entwistle & Ramsden 1983), see Figure 1.1.

Kay then turned to the Wakeham Review of the employability of STEM graduates, which reported a gap between graduate capabilities and employer expectations, and stressed the responsibility of universities to equip students with tools to 'reinvent and upskill themselves' over the course of their career (Wakeham 2016).

The provocation in this talk was that students would engage with their learning in different ways, that assessment is a powerful influence on students, that universities are failing to fully and effectively equip students for the imminent and future workplace, and that – therefore – it is critical that all assessment should contribute to helping students learn and succeed. Against this backdrop, it is difficult to justify the prevalence of closed book, summative assessments that have been so prone to disruption by COVID-19. At this point, participants were asked what kinds of emergency assessment responses they were using from a list that included:

- Take-home exams
- Synchronous open book exams
- Changing exams to coursework
- Changing oral presentations to videos
- Adjusting module learning outcomes
- Reducing the scope of modules

About a third of participants said they were using 3-4 of these strategies, a sixth were using 5-6 and a quarter had deployed 2 or fewer.

In developing alternative assessment approaches, Kay urged participants

---

[1] Adapted from Hack, 2020.

to use the disruption as an opportunity to critically consider how fit-for-purpose our assessments are, by asking whether:

- we understand what accreditation *actually* requires, rather than what we think or assume it requires
- we have enough variety in assessment tasks to achieve the breadth of outcomes we seek
- our assessment modes are complicit in promoting strategic or shallow learning, and whether it relies to heavily on recall under controlled conditions
- we are integrating assessment strategies across programmes, or whether we have too many small pieces of assessment
- we acknowledge the information students have at their fingertips, and ask them to do something meaningful with it
- we are engaging students with the real purpose of assessment, and Higher Education

In the answers to these questions, we can find long-term impact from our crisis responses.

In breakout rooms, small groups of participants reflected on their experience of assessment under COVID-19. One question asked participants what would help them make decisions about learning, teaching and assessment in the 2020-21 academic year. Responses included: identifying best practice, a better awareness of what tools and techniques are available and what they do, research that facilitates students using specialist software off-campus, a real understanding of what could be online and what needed to be face to face, guidance from accrediting bodies as to what is 'acceptable', and – very strongly – more effective partnerships with students to understand what works for them and what their experience has been.

The final question participants contributed to was on the barriers that might stop them from continuing with the assessment changes they had introduced. Responses included: being urged to return to 'business as usual', concerns that marking workload of online assessments will be higher, the potential for academic misconduct by students, inability of open book assessments to differentiate students, the challenge of considering students in different time zones or with different hardware/technology access, and a desire to return to richer processes – for example in research project supervision, practical work and peer collaboration. Two months have passed since this first webinar, and we can reflect how much progress we have made on these early needs and concerns, and how much our understanding has developed.

Cases of Practice

In this section we share four fresh examples of assessment innovations that have been stimulated or tested by COVID-19. **Candice Majewski** (University of Sheffield) introduced video submissions as a replacement for a written examination that was failing to capture the outcomes the module sought to develop. **Evripides Loukaides** (University of Bath) introduced frequent quizzes with randomised questions in the VLE that generated insight into student progress and common difficulties. **Sahar Al-Sudani** (King's College London) introduced a flexible and inclusive group assessment in response to COVID-19, allowing students to choose their own format in communicating research the group has carried out. **Stephen Beck** (University of Sheffield) shares his philosophy of threshold assessment, and the power of separating out a minimal threshold for accreditation purposes, directing a partial assessment at establishing whether or not the threshold has been met. We hope these cases offer encouragement, reassurance and inspiration; do get in touch with the contacts if you would like to hear more.

Case Study 1.1
Candice Majewski
University of Sheffield

What was your innovation and its context?
We had previously run two separate 10 credit modules related to Additive Manufacturing (3D printing), which we combined into one 15 credit module (for approximately 65 students). This meant a lot of thought about what were the good bits we wanted to keep, what things weren't adding value, and what else we wanted to include. One thing we thought wasn't working well was our assessment (one module was 100% written examination, and one was a group written report). We felt that these didn't reflect the nature of the new module, which has a large emphasis on open discussions, encouraging our students to form opinions, and an underlying understanding that there's often not a single 'right' answer. So, we decided to keep an element of groupwork, with students in groups of 5 or 6, and a simple brief to identify and justify a product that would benefit from using Additive Manufacturing. We provided information about the type of information we wanted to see, and held drop-in feedback sessions throughout the six-week project so students could run ideas past us and check that they were on track. Submission was in the form of a 20-minute video presentation, which could be in whichever format the group preferred.

What were the positive things about the change?
Submissions were really varied in terms of the approach the students took; some followed a 'standard' PowerPoint presentation with narration, others chose to video themselves speaking and showing props, and one group produced a 'newsreel'-style video with rolling text and images. As well as allowing the groups to be creative in how they presented us with the relevant information, this variety had the unexpected bonus of making it easier for us to mark; I was almost sad when I'd finished marking them all! The 20-minute time limit (given as a guideline rather than a strict rule) turned out to be very appropriate – enough time for the groups to get into some technical detail, but not so long that they ran out of steam. Allowing the students to choose something they thought was interesting worked well, as the majority of the groups really seemed to engage with whichever product they selected.

What was challenging/less effective about the change?
As this was the first time we had run this type of assessment, we specifically requested additional feedback from our students in order to gauge their opinions on how well it worked. One key point raised was that some groups took a while to decide which product they would focus on, leaving them less time to work on developing their justifications. For various reasons, we cannot allocate groups at the start of the module, but a suggestion from the students was that we could share the details of the coursework at the start of the semester, so they could be giving some individual thought to the best product or sector to focus on. This was really useful feedback, and is something we'll be implementing for next semester.

What advice would you give to colleagues interested in implementing or building on your innovation?
Being clear with your students about what you're expecting from them is really important, especially as they may not be used to this sort of submission format. In this case, one of the most significant things was to reassure the groups that we weren't judging them on their slick camera skills, quality of their recording equipment, or on their editing skills! This allowed them time and space to really focus on the tone, content and overall message of their presentations.

Case Study 1.2
Evripides Loukaides
University of Bath

What was your innovation and its context?
The innovation was the introduction of online quizzes for a large cohort (>250) of second year Mechanical Engineering students in a Manufacturing Operations and Technology module. Three quizzes were used at regular intervals during the semester. The students were allowed 15 minutes to answer a mix of ten multiple choice and short answer questions. They attempted the quiz at their own time and were given a one-week window for their attempt. The module has distinct quantitative and qualitative aspects. It introduces the mechanics of common manufacturing processes, such as casting and machining, but also provides a first immersion in the world of operations management. Hence, the material is diverse and the focus is shifted frequently. At the same time, second year students have several demanding modules running in parallel. The quizzes were created on the Moodle platform, using a large number of randomisation options within Moodle, so as to provide a fair and uniform assessment, while minimizing the potential for abuse.

What were the positive things about the change?
From the educator's perspective, the quizzes allow a consistent method to assess progress and identify areas that are proving challenging for the students. As a form of assessment, the automated features of the Moodle platform reduce the time cost of marking, but provide a robust evaluation of performance. The many features of the platform allow the same questions to be presented in different order and with different numerical inputs to each student. When combined with a large question bank, the system can produce a huge number of distinct quizzes, thus avoiding the possibility of abuse. From the students' perspective, it gives both the motivation to revise at regular intervals and immediate feedback on topics that require additional study.

What was challenging/less effective about the change?
Setting up a large question bank was a challenge, and a lot of effort was required to produce a consistent level of difficulty.[2] At the same time finding the optimal

_____

[2] Editor's Note: A point that is repeatedly raised about multiple-choice tests – and appearing explicitly in this case study – is related to the upfront effort of building a large bank of questions, seen to be key to the randomisation that helps mitigate collusion and plagiarism. Is now the time for the sector to collaborate to build and share question

duration for the quiz, both for the attempt itself and for the availability of the quiz, was difficult. Furthermore, for certain quantitative aspects of the course, developing challenging questions in the multiple choice or short answer format can be problematic or impossible. Because of technological limitations, visual information can be challenging to communicate in the questions.

What advice would you give to colleagues interested in implementing or building on your innovation?
A first suggestion would be to keep this form of assessment as a relatively minor component of the overall assessment, especially for initial iterations. In addition, as noted above, there is great value in having a question bank with many more questions than needed for each attempt. This allows randomization and provides a separate experience for each student. Finally, such quizzes work very constructively when sections of the final exam have a similar format, either as multiple choice or as short answers, hence colleagues might want to consider the overall synergies with other forms of assessment.

Case Study 1.3
Sahar Al-Sudani
King's College London

What was your innovation and its context?
To give some context of our approach on innovative assessment. The assessment that will be presented here is related to a second-year computer science module named: Operating systems and Concurrency. The assessment of this module was 15% weekly quizzes and 85% unseen final examination. Unseen final examinations are usually considered of highest integrity, but with the given circumstances of the pandemic, exams will not be the optimal option. Adjusting the assessment to include continuous assessment will guarantee that students will be fairly and consistently assessed in this unique situation. The module and assessment will be delivered online. The new assessment will be 10% of the mark for weekly quizzes to improve students engagement, 30% for mid-term online exam, 20% for groupwork and 40% for final online-exam. All the online-exams as open book – that is, no proctoring will be available.

To be more creative, I introduced a new form of assessment that has not been implemented before in the Department of Informatics at King's College London. Students will work in groups of 5-6 and they are required to select a

---

banks of multiple-choice questions on fundamental topics?

topic to research and present. The general themes of the research topics will be given to students in advance. The assessment is flexible and inclusive: it allows students to select the method to present their findings which better suits their learning styles and personalities. It could be a form of 10 minutes recorded video, 3 slides Powerpoint presentation, a new program to resolve an existing real life problem, or a poster with 800 words explanation.

What were the positive things about the change?
The positive outcome of this new type of assessment is summarised in the points below:

1. The key feature of this assessment is the creativity. Students are required to be creative in presenting their findings. There will be marks allocated for creativity.
2. Students will engage in a groupwork activity that develops their teamworking skills and enhances their engagement with their studies, given the high interaction among students in a group setting.
3. Students can work with colleagues that they feel comfortable to work with.
4. Student take ownership of their learning, given that they have to decide on the topic, the research method, and the method of presentation.
5. Encourage peer learning, which has been acknowledged in the literature as an effective method of learning.

What was challenging/less effective about the change?
The challenge could be group formation and how much I can contribute in that process. I am thinking of using MBTI personality test to help students identify their personality types and decide on group members.

What advice would you give to colleagues interested in implementing or building on your innovation?
Generally, having more than one form of assessment in a module is a good practice. The key question is how to ensure that assessments provide a combination of components that are constructively aligned with the intended learning outcomes. I believe this group work assessment is an example of good practice to improve students' engagement with their studies and with the other assessment components of the module have addressed all the learning outcomes of the module.

Case Study 1.4
Stephen Beck
University of Sheffield

What was your innovation and its context?

I have always been concerned about the way that we examine students. Typically, 40% is a pass, but which 40%, and more importantly, what does that pass represent? On a typical examination with a rubric of 'do 3 questions out of 5', it is possible to pass by getting full marks on one question and 1/4 of another one: so one can 'pass' the course by engaging with 25% of it. That's a lot of learning outcomes that have been missed, learning outcomes which the Engineering Council requires that each student must demonstrate.

For a long time, I have been concerned with this, so I developed the concept of 'threshold assessment'. Here, one just examines up to the pass. Typically in engineering subjects, this will be analysis and basic knowledge and capability. Generally, these are elements that can be taught and learned. We must not forget what a pass is: it is the bare achievement of all the learning outcomes for a module or a course. These can usually be tested using multiple choice questions, short answers, tutorial questions, or even question and answer sessions. This shifts our attention to whether the student is competent, not how good they are. Once students have shown that they have achieved the threshold (generally by showing us that they can do what we've told them to), we can then ask them to demonstrate how good they are using a different assessment technique, usually looking for synthesis. I deem this to be mastery.

What was your innovation and its context?

In my first year thermofluids course, I do this by having a 'Part A' with multiple choice questions where I demand students get a high mark in order to pass the module. As a believer in constructive alignment, I also provide a series of similar multiple choice questions in the VLE, so students can practise and know what they need to do to achieve the threshold and pass the module. To provide a record of how good students are, and to provide a mark between 40 and 100, I have some longer questions of the more conventional type, that stretch students and allow them to demonstrate the integration of their learning. This shows how good they are at the subject. A number of students do not attempt these, but are still able to pass the module, but barely. I know that these students have achieved the learning outcomes, because I have tested these robustly.

What was challenging/less effective about the change?

This year, at the University of Sheffield, face-to-face examinations were stopped

and the University, moved first year examinations to threshold pass/fail. I was unconvinced that sending students home with a paper was any more robust than informing them that they would pass if they completed all of the 100 odd multiple choice questions that I had written on the VLE for practice (and got them all right). At least this way, I could be sure that they have engaged with the entire course and had achieved the threshold pass and the learning outcomes.

What advice would you give to colleagues interested in implementing or building on your innovation?
Be very clear about what you are trying to assess. What is a pass? If a student gets a pass, have they shown that they can do what the learning outcomes state they can, but no more? Also think, what is mastery. In this, there is no need to check on the basics or cover the whole syllabus. It can even be part of another assessment or project where they need to use the skills. Above all, think 'what am I trying to assess?', and what is the best way of testing for threshold and mastery separately.

Student Perspectives

Throughout this section, student surnames refer to the student perspectives presented alphabetically by surname in Part 2 of this volume.

Many students chose assessment as their focal point in sharing their perspectives with us, perhaps speaking to the primacy of assessment as much as coincidental timing of the call with the assessment period. Their views spoke positively of assessments that pursued higher level (or clearer) learning outcomes, and many shared vivid accounts of the circumstances in which they undertook assessment.

For some students (notwithstanding a long period of uncertainty that many mention), the move away from closed book, invigilated exams has been welcome: 'I actually now feel more confident in undertaking [exams] … the pressure of memorisation and repetition has now been alleviated, and I can now focus on demonstrating and applying my understanding without fear of forgetting supposedly trivial facts or formulae' (Whittle). Others comment on the artificiality of closed book formats: 'Exams need to change so that they aren't based on memory but are based on application, as this is more realistic for the working world ... Problem solving exams would allow for content from several different modules to be assessed together, further developing

engineering skills' (Nicholls), and 'although [coursework] assignments are not perfect, they can provide a real world environment. For instance, a person can always ask for help and search for information on the Internet.' (Anonymous 9). One student comments on how a different assessment format shifted the basis of their engagement with the whole module: 'I also changed my style of learning to suit open book exams: I anticipated more difficult and different exams to really test my understanding. As such, I spent more time learning the real content of the module, rather than studying past papers to assess question structure and patterns, which I usually do to help me in the exams' (Boland).

Students also wrote about how they experienced the practical arrangements surrounding online exams, 'The exam timetable allowed me to take the exam any time within a 24-hour period, so I could choose whether I preferred a morning or afternoon exam. This choice alleviates some stress and anxiety for afternoon exams. Afternoon exams allow for revision in the morning, which can be good but also cause stress if you start to believe you don't know enough' (Nicholls), 'I also appreciated the 24-hour period of all my exams, which allowed for comfort and preparation, meaning I began every exam in a good, calm state of mind' (Boland), and 'Additionally, the fact that they could start at our own convenience (within reason) greatly calmed my nerves' (Anonymous 4).

Some students shared the more challenging contexts in which they undertook online exams: 'I share caring responsibilities for my elderly grandmother, who has dementia. This means that for me, it can be difficult at times to get three straight hours of quiet time...however, with the 48 hour window I was able to care for my grandmother, whilst also being able to find three hours within this period to complete my assessment and upload' (Anzak), and the more succinct 'Having to do my last exam on the kitchen table with my neighbour's baby screaming was peculiar, to say the least' (Anonymous 5). One student spoke of the mismatch between lecturers' expectations when setting work, and students' experiences 'an exam designed with a recommended time of 3 hours took most students an average time of 16 hours and some even more...' (Anonymous 9).

Some students submitted perspectives that mentioned their experiences with 'threshold assessment' (which led to the author soliciting Case Study 4 in this chapter). Lecturers who had used their existing assessment and moved it online without adjustment were critiqued by students for lack of value and impracticality ('It's an understatement to say that doing integration by typing is as confusing as it gets' (Anonymous 5)), whereas thoughtfulness was noted, and valued. Separating out assessment of competence (threshold assessments) from that of mastery, 'is a method that should be made compulsory across all modules to ensure consistency across the board' (Casedei), and 'the fairest

way to assess us' (Anonymous 3). It was noted that a pass through competence would support progression and safety net benefits, whereas graded assessments gave students the opportunity to distinguish themselves.

Many students who shared their perspectives were frustrated at not knowing how they were going to be assessed for what they felt were extended periods of time. It has caused stress and anxiety, and many student perspectives mention this. Although this was largely unavoidable in the first part of this year, for the wellbeing of our students – and our CMA compliance – this must be avoided going forward. This year will have shown us the advantages and disadvantages of a variety of alternative assessment methods, and this work aims to add to that understanding. Looking ahead, to respond to this student concern and emerge stronger, we could do worse than consider resilience of assessment formats as well as reliability, validity and fairness.

References

Boitshwarelo, B., Reedy, A. K., & Billany, T. (2017). Envisioning the use of online tests in assessing twenty-first century learning: a literature review. *Research and Practice in Technology Enhanced Learning*, 12(1), 16.

Boud, D., & Falchikov, N. (Eds.). (2007). *Rethinking assessment in higher education: Learning for the longer term*. London: Routledge.

Cormack, A. (2020) Technology can reduce exam stress – for both candidate and invigilator, 13 May 2020. Available at: www.jisc.ac.uk/blog/technology-can-reduce-exam-stress-for-both-candidate-and-invigilator-13-may-2020. Accessed: 5 July 2020.

Engineering Council (2014) *The Accreditation of Higher Education Programmes*. 3rd Edition. Engineering Council.

Engineering Council (2020) COVID19: Information for higher education providers, issue 1.1., 9 April 2020. [Available at: www.engc.org.uk/engcdocuments/internet/website/COVID%2019%20Information%20for%20HE%20providers.pdf. Accessed: 17 July 2020.

Entwistle, NJ. & Ramsden, P. (1983) *Understanding Student Learning*. London: Croom Helm.

Gibbs, Graham (2006) 'How Assessment Frames Student Learning' p101-113 *in* Bryan, C & Clegg, K (eds.) *Innovative Assessment in Higher Education*. London: Routledge.

Hack, K. (2020) 'What are we learning about assessment?' *Educating Engineers: Lasting Impact From Crisis Innovation*. York: Advance HE Connect. [Webinar, 19 May 2020].

Heywood, John (2016) *The Assessment of Learning in Engineering Education:*

Practice and Policy. IEEE Press. Piscataway, NJ.

Jisc (2018) Designing learning and assessment in a digital age: Assessment Available at: www.jisc.ac.uk/guides/designing-learning-and-assessment-in-a-digital-age/assessment. Accessed: 5 July 2020.

Jisc (2020) Assessment 2020: What happened – and what next? Available at: www.jisc.ac.uk/news/assessment-2020-what-happened-and-what-next-11-jun-2020. Accessed: 5 July 2020.

Lancaster, T. (2020) Assessing With Integrity: The Role of Technology. Webinar for QAA, 23 April 2020. Available at www.thomaslancaster.co.uk/blog/assessing-with-integrity-the-role-of-technology-webinar-slides. Accessed: 13 July 2020.

QAA (2018) UK Quality Code for Higher Education. Advice and Guidance: Assessment. Available at: www.qaa.ac.uk/en/quality-code/advice-and-guidance/assessment. Accessed: 5 July 2020.

Race, Phil (2020) *The Lecturer's Toolkit: A practical guide to assessment, learning and teaching*. 5th Edition. Abingdon: Routledge.

Royal Academy of Engineering (2010) Engineering Graduates for Industry Available at: www.raeng.org.uk/publications/reports/engineering-graduates-for-industry-report. Accessed: 5 July 2020.

Wakeham, W. (2016) *Wakeham Review of STEM Degree Provision and Graduate Employability*. London: Department for Business, Innovation and Skills/Higher Education Funding Council. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/518582/ind-16-6-wakeham-review-stem-graduate-employability.pdf. Accessed: 17 July 2020.

Wiliam, D. (2011). What is assessment for learning? *Studies in educational evaluation*, 37(1), 3-14.

Wood, G. C. & Gibbs, B. (2020). *COVID-19 Crisis: Transitioning from traditional invigilated exams to 'take-home' exam papers*. Sheffield: University of Sheffield. Available at: www.garycwood.uk/2020/04/covid-19-crisis-transitioning-from.html. Accessed: 5 July 2020.

Chapter 2

How do we protect students' collaboration skills?

Steve Cayzer
University of Bath

• •

This chapter takes collaboration amongst students as its central focus, recognising the significant impact COVID-19 induced physical distancing has on collaboration - a learning activity that supports the student experience and is a critical learning outcome in the development of professional engineers. Its call to action draws attention to the importance of team dynamics, and asks us to be thoughtful and rigorous in considering how students are being supported to work together synchronously, asynchronously, and informally. Colleagues are invited to evaluate whether (now rarer) moments of spatial and temporal synchronous activity are being used for maximum value which is – we argue – allowing students to work together in collaboration.

Collaboration skills are increasingly key in the engineering sector, as is clear from their prominence in the UK SPEC (Engineering Council, 2013). In our conversations with students, social connectedness has been repeatedly called out as a key factor in their learning experience, mental wellbeing, and effectiveness. Collaboration drives engagement and enjoyment – in other words, collaboration is what makes engineering education fun. More profoundly, collaboration can have a major impact on students' mental wellbeing, with team working potentially being more effective than individual training on resilience (Wessely 2020).

The importance of collaboration is highlighted by the results of a recent poll for the *Lasting Impact in Crisis Innovation* webinar (Cayzer & Sutcliffe 2020), where all respondents agreed that collaboration skills were 'essential' in engineering education and must be preserved. Yet only around 25% were 'confident' we could deliver these in an online world, with the majority being
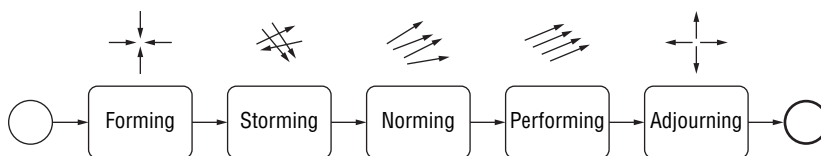
Figure 2.1: Representation of Tuckman's stages of team formation[1]

'hopeful'. In this chapter we discuss the experience of educators and students, and present some considerations for us to bear in mind as we design our courses to take account of, and even benefit from, a blended environment.

In one sense, collaboration is straightforward. Modern virtual learning environments offer a convenient virtual hub for students to congregate, share material, schedule video meetings and communicate in a number of ways. Yet, at a deeper level, we need to intentionally design our learning experiences to maximise their impact.

For example, it is well known that as teams develop, they go through a number of stages (Tuckman & Jensen 1977), as shown in Figure 2.1.

Forming: here, team members are polite and friendly; conversation is focused around areas where conflict is unlikely. This has been described as the honeymoon phase of team formation, and so emotions are usually quite positive. It is normal for this phase also to be a bit intimidating for some people, particularly shy people or non-native speakers.

Storming: team members feel more confident to express their opinions – even if these cause conflict. Arguments are common in this phase. A 'struggle for dominance' occurs if multiple people want to 'lead' the team. Sometimes an external 'threat' (eg competition with another team) brings the team together.

Norming refers to the phase in which roles and processes are agreed upon, formally or informally. The team culture is established – how we do things around here' Students feel more like a team at this stage. It can take quite a while (20-30 hours of meaningful activity) before a team starts to norm.

Performing: here the team has reached peak productivity. Even where there are differences between team members, these are managed well. The team is focused on the task at hand and team members trust each other to deliver.

Adjourning is the end stage (typically towards the end of a course or semester). Team members may worry about the impending break-up of their

---

[1] Adapted from DIogo Nicoleti CC BY-SA 4.0. https://commons.wikimedia.org/w/index.php?curid=44293179.

'family'. Such anxiety can lead to conflict. Outsiders are treated with particular suspicion.

Our learning activities need to take account of these stages and team dynamics, with emphasis on social bonding at the early stages, mechanisms for conflict resolution (including the giving and receiving of constructive feedback, and self and team reflection), and the use of team charters to create a common purpose.

Perhaps we also need to recognise the importance of spatial and temporal synchronicity – that is, a group of students gathered in the same (virtual) space and the same time. Rather than squandering that gift by 'talking at' the students, we should perhaps use the opportunity for peer engagement: students working together to tackle meaningful challenges. Of course, we must not forget the importance of asynchronous collaboration, particularly for students working in different timezones, with unreliable Internet access, or those with financial constraints. We must also recognise the importance of informal communication – social bonding is a key contributor to team effectiveness.

Collaboration can also encompass staff-student relationships, including the co-design of curricula and learning experiences, and this theme is explored in Chapter 5.

In the rest of this chapter we summarise the activity of the Advance HE Network on this topic, and introduce some case studies from both staff and students. It is hoped these will provide some tangible and pragmatic guidance for engineering educators as we design learning activities with collaboration skills at their core.

Network Activity

In the *Lasting Impact from Crisis Innovation* webinar (Cayzer & Sutcliffe 2020), we demonstrated a way of encouraging collaboration between the participants. Dividing participants into teams, we posed a set of questions, each designed to spark significant nuanced discussions, but with a specific, easily comparable output. The teams posted their answers on a web-based collaborative platform (Padlet). This activity conforms to what the Team Based Learning community call a 4S activity (significant, specific, same and (almost) simultaneous; Michaelson & Sweet 2008).

We asked participants four key questions around collaboration intended to provoke discussion and draw out best practice.

Keep: What is the *most* important aspect of collaboration that we want to preserve?
   a. Team dynamics
   b. Team interaction – intra team
   c. Team interaction – inter team
   d. Targeted Facilitation
   e. Other

The answers were evenly split among the options, with the exception of C which got no votes. This is interesting because the use of Padlet is intended to allow teams to compare their thinking with other teams. In the context of a one hour session, this might have been a little difficult for participants to manage. This was underlined by a lively plenary discussion which surfaced the need to offer facilitation, particularly in earlier years where students are still building collaboration skills.

Adopt: What is the *most* useful current practice (for collaboration) that you would like to see adopted more widely?
   a. Constrained Activities (the 4S principle)
   b. Use of breakout rooms, channels, etc
   c. Making connections more personal (e.g. video)
   d. Students interacting socially with each other and staff
   e. Other

There was a clear preference for option D and this is backed up by student voice, as summarised below. In the webinar plenary, it was noted that this is perhaps a development need for educators. Certainly, the need to reformulate context to promote an interactive learning experience is a significant challenge.

Innovate: What is the *most* exciting opportunity you see for improving collaboration?
   a. Richer, more inclusive collaboration (e.g. 'introverts')
   b. Wider participation (socioeconomic, geographic, demographic)
   c. More realistic collaboration (models international organisations)
   d. Learning analytics to measure collaboration
   e. Other

There was a preference for realistic collaborations (C), showing a link to employability (Chapter 4). There was also interest in the potential inclusive advantages of online collaboration, which suggests we should take the inclusive

advantages of active learning (McNeil et al 2019) into the online realm.

Support: What is the *most* pressing need you would have to support collaboration?
a. Government or accrediting body support for online collaboration
b. Community of practice – e.g. repository of best practice, mentor/peer support
c. Local training or support
d. Financial eg software licences, teaching support
e. Other

There was a clear preference for the development of a community of practice, which underlines the importance of networks like Advance HE and the Engineering Professors' Council. Financial needs (D) were – perhaps unsurprisingly – highlighted. In the plenary we discussed the importance of making a strategic business case; a community of practice could be a valuable source of evidence and support for this case.

Cases of Practice

In this section we share five innovations related to student collaboration that have been necessitated or implemented in a COVID-19 context. **Caroline Dominguez** & **Adelaide Cerveira** (University of Trás-os-Montes and Alto Douro, Portugal) discuss a collaborative project related to sustainability that involved Scrum approaches, the Trello platform, and online surveys, programming and stakeholder meetings. **Judy Raper** and **Sarah Campbell** (TEDI-London) pivoted from a face-to-face project-based, on-campus summer school to a virtual programme, whilst maintaining its core values of small group projects based on user-centred design and prototyping. **Alison Griffiths**, **Muhammad Majid Ali** and **Sandra Kirkham** (Staffordshire University) conducted a multi-cohort evaluation of face-to-face, online synchronous and online asynchronous delivery modes noting - amongst other things - how developing online collaboration skills has enhanced student employability. **Peter Berg** (Kingston University) is supervising an MSc project evaluating collaboration within and between teams, with Microsoft Teams as a technology driver. **Corrina Cory**, **Avalon Cory** and **Ceri Howells** (University of Exeter) implemented blended Gold Standard Project Based Learning (GSPBL) to first-year challenge projects, to develop 'twenty-first century' professional skills in students. We hope these cases offer encouragement, reassurance and inspiration; do get in touch with the contacts if you would like to hear more.

Case Study 2.1

Caroline Dominguez & Adelaide Cerveira
University of Trás-os-Montes and Alto Douro, Portugal

What was your innovation and its context?
Project the future: making the difference in our community – that is the challenge that a group of first-year Master mechanics engineering students launched themselves into, as part of the industrial management course at UTAD, Portugal. With the objective of deeply engaging in a project which would tackle the issue of decreasing the ecological footprint of the campus generated by local commutation from and to university, students acquired and developed the necessary skills for 'good' project management, using new ways of effective collaboration and communication, through technological tools. The problem formulation was made through a critical questioning of the situation at start. An agile planning and execution methodology was used, applying Scrum with the Trello platform. Students elaborated and sent an online survey to UTAD's students, and analysed the collected data to enable them to simulate a response, including routes optimization and assignment of passengers, using linear programming models (XPress software). Online meetings with the heads of various campus services followed, to get their collaboration. Finally, a model of local carsharing was designed, which will allow, when implemented, not only reduced ecological footprint, but also increased solidarity and conviviality between members of the academic community.

What were the positive things about the change?
The main change consisted of students adapting and using online technologies, acquiring the technical knowledge and at the same time fomenting strong collaborative work, in a specific project. This enabled students to take responsibility for contributing solutions for a social/economic/environmental problem.

What was challenging/less effective about the change?
There were two main challenges. The first one was the difference of students' backgrounds, in particular regarding the technological skills, which obliged them to support each other. Another challenge was the fact that the team was constituted of working and non-working students, which led to some schedule and time management problems, which they had to solve. For the teachers, the most challenging aspect of the change was to find the best mode and criteria for evaluation. The online context presented no difficulty for supporting the students' work. It enabled the participation of companies which presented/discussed their project management practices.

What advice would you give to colleagues interested in implementing or building on your innovation?

Although it is important to plan the activities (preferably with the students) well in advance, teachers have to bear in mind that some flexibility is necessary to overcome unforeseen circumstances. We recommend the use of Padlet as a communication tool between teachers and students, and between themselves for the planning and execution of the different course activities. The fact that students engaged in a socially useful project, from its selection process through its planning and execution, enhanced their motivation in learning not only technical but also professional skills.

Case Study 2.2
Judy Raper & Sarah Campbell
TEDI-London

What was your innovation and its context?

TEDI-London, an aspiring engineering higher education provider, based in Canada Water, pivoted from a face-to-face project-based, on-campus summer school to deliver the six-week programme virtually whilst maintaining the core values of small group projects based on user-centred design and prototyping. The summer school aimed to have the students design solutions to make Canada Water a dementia-friendly environment, as part of British Land's Canada Water Masterplan redevelopment. The pivot enabled the programme to be opened up more widely: 147 students from 21 countries, across a twenty-hour time zone spread attended the free online summer school. Fifteen interdisciplinary project teams (50% engineers/50% others) were created, each including students from at least four countries. With co-delivery from academics, industry, people living with dementia, and dementia experts from Australia, the UK and the USA, the programme incorporated webinars, design sprints, workshops, mentor sessions, and an industry-set 24-hour project, using the 24-hour global working model. Weekly formative assessments on individual self-reflection and group reports provided ongoing feedback, to enable students to perform their best in the final assessment and pitch to an industry panel.

What were the positive things about the change?

The change enabled the summer school to be opened up more widely, enabling access to many more students, from both developed and developing countries. Additionally, many of the mentors and contributors would not have been able

to attend had the summer school been held in London. This offered students a truly global, interdisciplinary collaboration experience, with more teams, leading to fifteen innovative prototypes. Due to the time zone differences, students had to take responsibility for their contributions and those of the group, negotiating team dynamics and requiring collaboration, compromise and time management. Having global contributors enabled a timetable that ensured students from all time zones could attend live sessions, or to watch recorded sessions. Online delivery enabled much more efficient capture of feedback and data, meaning analytics could be used to track student engagement, enabling early identification of engagement issues, which led to only nine students dropping out across the six weeks.

What was challenging/less effective about the change?
In the first week, it was challenging to get students to engage during sessions in the online environment. The requirement to have attendees muted during sessions, with many choosing to have their cameras off, set a precedent for a lack of confidence to speak up. This changed across the week, particularly following sessions with breakout rooms, and increasingly students became more engaged. It was hard for TEDI-London staff to get to know quieter students, and feedback from contributors was much more important. We were not expecting such a detailed level of assignments each week, and with the need for quick assessment feedback, the turnaround time for marking was a challenge. Facilitating procurement of prototype parts and access to facilities to create prototypes during lockdown was challenging. Certain structures in the online environment worked less well: the social sessions were less effective, although following feedback and adjustment they were better attended.

What advice would you give to colleagues interested in implementing or building on your innovation?
Understand and test the online platform. Be mindful of the number of online channels/areas being used and the amount of content, to avoid overwhelming students. Have a very clear structure and guidelines for channel use, along with daily announcements and posts. Build in automated tracking and feedback. Be prepared to collect ongoing feedback and adjust the programme. Set clear expectations of students. Using a co-delivery model with industry, academics (and people with dementia) is a great approach. Have business planning and commercial viability as core. Capitalise on the amount of content, information and data that can be created and recorded.

Case Study 2.3

Alison Griffiths, Muhammad Majid Ali & Sandra Kirkham
Staffordshire University

What was your innovation and its context?

We developed a questionnaire, to obtain views of engineering students in the following scenarios:

1. Undergraduate distance learning teaching to 100 face-to-face students at a French University over a short time period – 4 weeks asynchronous, and 2 weeks synchronous learning with a project, April-June 2020.
2. Ministry of Defence (MoD) undergraduate distance learning courses, where the learners have a wealth of practical experience, but lack the theoretical underpinning.
3. Blended learning for traditional face-to-face undergraduate and postgraduate teaching, including international engineering students.

So far, 8% of the Staffordshire University engineering student population (107/1350 learners) have responded to the survey. 20% are international face-to-face learners who have completed a module by distance learning, 28% are part-time distance learners and approximately 50% of respondents are face-to-face learners who studied 9/13 weeks on campus, and remainder of the semester by distance learning.

What were the positive things about the change?

Global students reported having easy access to the Internet for their studies. More students have gained analytical problem-solving skills because of the online pedagogical approach. This is particularly apparent with final year undergraduate students completing their final projects. Engagement and participation within lecture sessions has improved, either via oral communication or chat messages. This has led to students engaging with a higher level of self-directed work. Online communication skills among the students and lecturers have improved. International students specifically liked the recorded sessions as they can listen to them in their own time. Allowing students to work in groups online, enhanced their teamworking skills, which is beneficial for employability. Students have developed skills in the use of industry-standard software, via online laboratory sessions, which also improves their employability potential. Facilitated screen sharing allows students to work collaboratively with peers and tutors.

What was challenging/less effective about the change?

It was particularly challenging to make sure all the staff and students were able

to use the e-learning environment effectively, as well as carry out significant work in a timely manner, either as a team or as an independent learner. The international students felt less motivated for self-directed study when compared to on-campus Staffordshire University students, but this could be due to the different expectations of their cultures. The international students were also the subgroup that least preferred the online format. Nevertheless, they reported a positive experience of online learning, therefore this may be culturally related. Online lab sessions are preferred by distance learning students as they are already used to it, but it becomes a new challenge for blended learners to perform online laboratory sessions. As a comparison, at Staffordshire University, there are also a large proportion of part-time students who also prefer online laboratory and lecture sessions.

What advice would you give to colleagues interested in implementing or building on your innovation?
Ensure that students have access to the technology that they require to access their learning effectively. Use pre-recorded asynchronous material for sessions for imparting fundamental knowledge and theory. Make synchronous lectures more problem-based, and use student monitoring software to enable real time engagement, feedback and attendance monitoring. Use formative assessment to reinforce learning between sessions. Obtain feedback from each student after each session and address issues raised between sessions. Ensure that when face-to-face teaching occurs, the practical work that cannot be carried out online is focused on when teaching in a blended learning manner.

Case Study 2.4
Peter Berg
Kingston University

What was your innovation and its context?
A MSc project is underway to develop a pilot for: collaboration between students to achieve a group assignment; collaboration between teams to share ideas effectively; oversight and management by a module leader/teacher; and including feedback opportunities. Microsoft Teams is the prime technology driver, within the existing Canvas infrastructure. The collaboration within a team can cover project start-up, team formation and maintenance, sharing of ideas and documentation, project management, communication, etc. Collaboration between teams investigates how processes/ideas can be shared, rather than just content. How will this be achieved without relying on

formal links but using intelligent organisation of collaborative channels? For example, in a project management module for all engineering pathways, can a Civil Engineering team collaborate effectively with an Aerospace Engineering team to help each other with the project management process? They cannot just copy each other's work, as their outcomes are different, but they could learn from each other's experiences. This research could be used to develop a methodology to enable collaboration between quite disparate teams. Can this be achieved with the minimum of administrative overhead and/or information overload? The pilot takes account of limiting factors – for example technology (device access, Internet connection, etc.), admin rights/security/University regulations, and training.

What were the positive things about the change?
The project will not be completed until mid-to-end of September. There has been quite a lot of interest in applying this to group projects for undergraduate students. In the short term it is hoped that the effectiveness of student collaboration can be maintained/enhanced whilst normal face-to-face contact is unavailable or severely restricted. In the medium to long term, the pilot can be developed further to create more learning opportunities for students across the schools and faculties. This is a MSc Project, so is by definition student-led. The outcome of this project, and follow-up projects to come, will be an opportunity for students to participate in learning and teaching development, including the design of modules. The project methodology includes student surveys to get feedback for the design stage. Further surveys will be used to refine and expand the applications.

What was challenging/less effective about the change?
I suspect the two key difficulties after October will be gaining traction in different courses, and securing student engagement – that is, showing the benefits clearly, other than via formative assessments. I am currently investigating work on group contracts that has been carried out by colleagues in the University. The project seminar and conference paper deliverables may require further work to 'spread the word'.

What advice would you give to colleagues interested in implementing or building on your innovation?
Using existing (or maybe creating new contact networks) is invaluable and further supports the need for this research into collaborative work. The PPPEE network is a very good example of generating ideas from, sometimes unrelated, pieces of work and opening up new sharing opportunities. The

appetite for sharing has never been so great.

Case Study 2.5
Corrina Cory, Avalon Cory & Ceri Howells
University of Exeter

What was your innovation and its context?
In an update to the engineering programmes at the University of Exeter, blended Gold Standard Project Based Learning (GSPBL) was applied to Year 1 Entrepreneurship and Multi-disciplinary Challenge Project modules. Facilitation, rather than teaching, is at the heart of projects, to develop students with a thirst for life-long learning, and inspire them to harness their human potential in preparation for the fourth industrial revolution. These modules aim to develop twenty-first century professional skills in students, such as collaboration, communication, innovative thinking, leadership, ethics and responsibility, adaptability, critical thinking, and problem solving. An authentic project launch, with industry guest lectures and new technologies, inspires students and scaffolded group activities facilitate students through a collaborative design process. The development of digital literacy is intertwined throughout the module, and students learn skills to create multimedia submissions. Academic staff involved in blended GSPBL have a high level of twenty-first century skills, and are inherently experimental. The academic skill set, and the structure of these modules in their blended form, are agile and can readily switch to fully-online teaching if required during the pandemic. However, further work is required to assess and mitigate the impact on student experience during these team-based modules during the next academic year.

What were the positive things about the change?
The design and construction of concurrent blended and online GSPBL has been a valuable process with a steep but exhilarating learning curve. It has alerted us to the enjoyment and productivity that can be gained by enhancing education with digital learning tools. GSPBL requires a high level of interaction between academics and students to develop a programme with a flat hierarchy and start-up culture. The Entrepreneurship module includes team-building activities co-designed with an Entrepreneur in Residence, and Lego Serious Play, both of which require a high level of interaction. The Multi-Disciplinary Challenge Project includes a fast-paced, low-pressure design sprint so students can fail fast and develop ideas over a short space of time. Activities include brainstorming, ideation and low-fi home-based prototyping. Online

collaboration during these team-based activities are facilitated by high-energy academics via Zoom and Mural to ensure students have an experiential collaboration experience.

What was challenging/less effective about the change?
Students in the first year are dealing with transition from a broad range of educational backgrounds, both in terms of quality of teaching and expereinces of assessment. GSPBL is challenging, with more open-ended questions and a world of possibilities for groups to explore. This exploration is seen by some as an opportunity for innovation, but others struggle with the vast range of options, and fear they are not capable of the innovative thinking required. Students can feel vulnerable in their first year around new peers, and this type of very exposed and open learning causes some social anxiety. We are yet to find out if these issues are reduced or increased with online activities, such as team building and design sprints. Perhaps the multiple methods of virtual communication will create opportunities for modification to these modules in the 'new normal'.

What advice would you give to colleagues interested in implementing or building on your innovation?
Blended GSPBL requires detailed virtual learning environments with a clear structure and a video user guide. A timeline video is useful, with the week-to-week flow of the project through the design process with week-by-week tiles. It is helpful for each week to include completed task tick boxes and expected hours of independent work. The initial activities should be extremely engaging and require academic staff to commit to breaking down barriers. These low risk, fun activities should generate discussion and build communication skills experientially. Quick polls and quizzes are great to regularly gauge student understanding, satisfaction and engagement.

Student Perspectives

Throughout this section, student surnames refer to the student perspectives presented alphabetically by surname in Part 2 of this volume.

Students appreciate that collaboration is a valued skill to develop. Interestingly, collaboration can be within a team or between teams – the collaborators might be working on different projects or courses but with useful experience to share. Of course, collaboration also covers staff-student relationships;

co-design of curricula is an important theme highlighted by Findlay and explored in Chapter 5. The students are keenly aware that collaboration is a key employability skill (see Chapter 4).

Boufidis noted the advantages of online for efficiency (no need to travel to campus), Heyworth enjoyed health benefits (time to cook properly and exercise), while Stainer and Wu took up new hobbies and pastimes. Several students (Boufidis, Soleye, Stainer, and Thomas) had honed their teamworking, organisational and time management skills during the shift to online, but stressed that students require training and support in order to effectively collaborate remotely.

Motivation (Boufidis, and Thomas) is a key challenge. According to our academic contributors, there is a need to address social anxiety in collaborative activities. Team building sessions can help address this, setting a 'flat' structure between instructors and students, with the use of 'serious play' activities and team charters. A socially useful, externally linked, authentic team project can be a great way to increase engaged collaboration. In fact, the move to online can create wider participation from staff, students or external partners, who may be remote or logistically unable to travel to the university.

Although online collaboration can promote diversity, Heyworth reported that home conditions can make concentration difficult and distraction all too likely, particularly since home is probably more crowded than usual. Indeed, a key need that emerged in the case studies was managing collaboration between students with varying skills, experience and logistic arrangements. Whittle missed the regular out-of-class contact with group members, while Thomas highlighted timezone issues. As Stainer stresses, students may not have equitable access to technology for a variety of reasons (Internet connection, hardware specification, restrictions on web access), and may be in financial hardship (Wu). Although this is perhaps obvious, it is essential to test logistics and software beforehand, for example the use of breakout rooms. Our academic contributors found that it is unwise to assume that students automatically know how to use the technology.

There was an intriguing interplay between asynchronous and synchronous modes of collaboration.

Synchronous sessions can be highly interactive with Abboushi and Crosbie valuing the 'live' link to staff, with questions 'easier to ask'. They noted that quizzes and polls can promote engagement (assessment is thoroughly explored in Chapter 1). They also proposed use of chat functionality to circumvent issues with background noise or connectivity, with Thomas noting that use of chat encourages quieter students or non-native speakers to engage. Our academic contributors advocated that these sessions should be problem

based, and stressed the need for good facilitation skills.

Yet synchronous sessions are not suitable for all activities (for example those requiring individual research, thought and reflection) and will not necessarily be accessible for all students, as mentioned above – so they should be recorded if possible.

Asynchronous collaboration therefore has an important role to play, Boufidis explaining that it maintains flexibility through the use of (for example) shared online documents and discussion boards for communication with lecturers. Thomas found it useful to ask questions for those unable to make the lecture for whatever reason. The recorded content is particularly welcomed by international students (probably due to the ability to review or repeat key points). Learning resources need to be adapted for the 'on demand' setting (not simply long, verbose, inefficient documents).

Several of our student contributors (Abboushi, Boufidis, and Heyworth) valued communication on 'non-academic' issues, underlining the importance of the pastoral function of collaboration. Whittle and Abboushi stressed the importance of informal communication for social cohesion and team bonding. This perhaps implies we should be considering online social events as well as formal teaching.

It is clear from our students (Abboushi, Stainer, and Crosbie) that they (rightfully) expect and value clear structure and guidance, particularly in the online world. Assessment criteria are clearly valuable but other guidance would include modelling of the appropriate format for a forum post, communication etiquette and staff 'office hours'. Other suggestions from our academic contributors include video guides, a weekly timetable with expected hours of study and tick boxes for activity completion.

Huang noted that 'personal feedback is important and often lacking online'. Findlay and Crosbie value frequent feedback with a quick (ideally instant) turnaround time, which implies the need for lightweight, efficient assessments (such as automated marking or self- or peer-assessed) as explored in Chapter 1. Of course, feedback goes both ways, and real time/ session feedback from students should be solicited and acted on promptly. Informal channels (such as social media) can be useful for lightweight ('quick' and 'short') communication, they also allow students to more easily share concerns.

References

Cayzer, S. & Sutcliffe, M. (2020) 'How Do We Protect Engineering Students'

Collaboration Skills?' *Educating Engineers: Lasting Impact From Crisis Innovation*. York: Advance HE Connect. [Webinar, 26 May 2020].

Engineering Council (2013) *UK Standard for Professional Engineering Competence*. Available at: www.engc.org.uk/standards-guidance/standards/uk-spec.

McNeil, J., Borg, M., Kerrigan, M., Waller, S., Richter, U., Berkson, R., Tweddell, S. & McCarter, R. (2019) *Scaling up Active Collaborative Learning for Student Success*. Report from HEFCE programme 'Addressing barriers to student success'. Available at: https://aclproject.org.uk/wp-content/uploads/2019/07/NTU-ABSS-Final-Report-revised-Oct-2019.pdf.

Michaelsen, L. K., & Sweet, M. (2008) The essential elements of team-based learning. *New directions for teaching and learning*, 116, 7-27.

Tuckman, B.W. & Jensen, M.A.C. (1977) Stages of small group development revisited. *Group and Organizational Studies*, 2(4), 419-427.

Wessely, S. (2020) The mental health challenge. Conference presentation. Fifth Festival of Higher Education (online) Available at: www.buckingham.ac.uk/event/fifth-festival-of-higher-education.

Chapter 3

How do we think about labs and practical skills in an online context?

John E Mitchell
UCL Centre for Engineering Education

∙∙∙

This chapter focuses on the challenge that COVID-19 induced closing of physical spaces has presented to students' participation in laboratory and practical work. Its call to action provokes a critical examination of the multiple learning outcomes that a practical activity is achieving, that can then be mapped against a wide range of possible learning activities that are able to support these outcomes. Colleagues are invited to recognise the value that digital artefacts, simulated practicals, remote participation, asynchronous participation by proxy and alternative environments can offer in a context where capacity in practical environments is extremely limited, or impossible.

Laboratory and practical skills-based activities are central elements of the learning experience for engineering students. While some aspects of these can only be delivered in a face-to-face mode, for many, there are ways to deliver something that can approximate an equivalent experience online. Even for those that need some face-to-face contact, it is possible that students can prepare for the face-to-face learning online, so that the use of contact time is maximised.

What has become clear, is that looking for direct replication of certain laboratory or practical activities online is a challenging path. As recommended in the *Pioneering Programmes and Practice in Engineering Education* webinar, *How do we think about labs in an online context?* (Garrard 2020), it is vital to start from the learning outcomes that you expect the students to achieve from any particular laboratory or practice experience. This then allows you to think about how the student might be guided to experience the key

outcomes in the online environment, rather than trying to implement a like-for-like replacement. This does bring to the fore consideration of the hidden curriculum, begging the question: are all learning outcomes explicitly stated? Especially in practical activities there are often implicit outcomes: things that we know students will take away from the physical nature of the activity that we don't always specify. Are these still vital or are they now a luxury that we can do without in this crisis situation? For example, the physical interaction with equipment as well as the interaction with other students in small groups of peers is often a key element of the learning experience that does not automatically translate to the online world.

In addition, the transition for staff can also be problematic. For facilitating staff, the ability to read the room, to quickly identify those groups that are struggling, heading in the wrong direction or those that progress well and need extension activities, is a natural part of the physical interaction. Online, these interactions are not as obvious and methods need to be found to replicate this vital scaffolding.

The types of responses that can offer real value in this constrained environment include (Garrard et al, 2020):

1. Provide digital artifacts
This is perhaps the most straightforward approximation to replacing labs, and is particularly useful for activities where analysis of results is a key learning outcome. It involves the creation of data, videos, and/or pictures that replicate what students could have obtained in the lab themselves. This allows students to watch the experiment and process the data without physically attending the lab. As it can be provided fully asynchronously, it is ideal for the online environment, and allows great flexibility for the students. It does, however, mean that the students have no control over what data to collect and they don't get any real interaction with the equipment. It may also be time-consuming to generate the core material.

2. Simulated Practicals
For fundamental laboratory classes, where a student (or small group of students) will undertake a reasonably prescribed set of operations on a set of equipment usually at a laboratory station or workbench, online simulation of the processes of the lab may be appropriate. Although open-ended laboratories are becoming more common (Chiu & Chiu 2004, Rahman et al 2011), these are still usually relatively constrained activities, with a set list of available equipment even if the student has more freedom to determine the experimental procedure. This approach is best suited to instances where

it is the experiment procedure that is central to the learning outcomes. The concept of remote labs has been widely studied (Rivera & Petrie 2016) and deployed (Gomes & Bogosyan 2009, Loro 2016), although typically as a complimentary addition to some face-to-face activity rather than as a full replacement. Examples of this may be the generation of a digital twin of an existing experiment. To do this in house is quite labour-intensive, and requires specialist support. There are, however, many commercially-available alternatives. For example, in science and life science, popular examples include Labster (www.labster.com), Learning Science (www.learningscience.co.uk), LT (www.adinstruments.com/lt), while in electrical engineering there are circuit simulation options, such as NI Multisim or TinkerCAD, which will emulate connecting hardware to an Arduino.

Although often an attempt at a direct replica for the physical experience, as can be seen from the student reflection later in this chapter, it is clear that students view these types of activities as not being equivalent to real experiences. The majority of the platforms mentioned here are marked as an augmentation for the physical lab, rather than a replacement. And although there are advantages to simulation – you can do things you can't in the real world – these approaches can be costly, and in trying to approximate the physical may inadvertently highlight elements of the experience that is lost.

3. Synchronous remote participation

This approach is gaining in popularity and has two possible approaches. The first involves a trained member of staff conducting the experiment live as an interaction experience. With careful camera placement or body worn cameras, students are able to ask questions and see real-time modifications to the experiment. A second alternative uses telemetry, and a remote control interface to allow students to directly interact with the equipment and then watch the outcome on a webcam. This is perhaps the most directly interactive form of remote lab, and inherently synchronous. However, it is also perhaps the most costly, either in staff time (typically at least two members of staff are needed, one to perform the experiment and one to control the stream, questions, etc.) or through the need for bespoke web-platforms. It is also the most difficult to scale, and therefore most appropriate for the more highly specialised processes and procedures.

4. Asynchronous participation by proxy

One of the trickiest areas to replicate is the make/prototype/build-type activities that are becoming more prevalent in engineering curricula and also very much enjoyed by students (Roach et al 2018). In this situation, students

would conduct, for example, the design of a device remotely, and submit the CAD file for manufacturing in a professionally-staffed facility. In some ways this mimics what is common in industry, where prototype designs are sent to model shops or workshops for manufacture. This can be a particularly powerful approach, if there is capacity for discussion and feedback on the design, specifically looking at its manufacturability, although again issues of scalability and the staff resource available might limit this approach.

5. Perform procedure in alternative environment
There will always be some learning outcomes where the physical interaction is central to the experience. In these situations, take home kits or activities that make use of easily available materials may be the most suitable replacement. We are seeing colleagues develop small kits of ideas that allow students to conduct experimentations at home. These typically include basic measurement equipment, such as scales or NI myDAQs, but may also include the use of phone-based apps, such as PhyBox which will support a range of physical measures. There are, however, some challenges which must be considered, most notably regarding potential health and safety issues (and the potential need for risk assessment – although this is likely a key learning outcome in itself), but also considerations of equity. Not all students will have access to the private space and resources necessary to conduct even the activities, and this should be considered in planning.

Looking forward, the pivot back to face-to-face interaction will come, but what will remain? It seems inevitable that while both staff and students will want to return to as much time in the lab as possible, the innovations that we are seeing through the crisis will open up new opportunities to improve the efficiencies of practical activities – what was described in the webinar as 'remote enhanced practicals'. There has been interest in how to support the in-class activities from some time, for example in Chemistry (Domin, 1999), however, this review of learning outcomes, and the decision being taken to access the most effective and efficient way to deliver them, will undoubtedly be able to influence the formation of future laboratory activities.

Network Activity

The *Lasting Impact from Crisis Innovation* webinar, *How do we think about labs in an online context?* (Garrard 2020) considered how close examination of learning outcomes was a route by which the community could break down

the problem of trying to move labs online. To open the session, the audience was asked, 'Which of these reasons for practicals do you think is most difficult to replicate when learning online?'. Overwhelmingly, the audience considered 'developing a range of experimental competencies', over 'illuminating physical concepts', 'integrating theoretical and practical learning', 'solving problems using experimentation', or 'making it fun, engaging and inspirational'. In the webinar, the approach outlined above was presented, with participants asked specifically to consider if the process of alignment to the categorizations above was subjective or objective. Interestingly, the majority of the audience (>⅔) considered this to be a subjective process.

It has been identified that one of the key challenges ahead will be squaring the demands of accreditation with the emergency measures put in place at the end of the 2019-20 academic session, and the proposals for the 2020-21 academic session. Although in theory accreditation only specifies the learning outcomes and not how they are met, there are a number of learning outcomes that would clearly imply practical activities and that are hard to replicate online or without some physical interaction. The demands of accreditation must also be seen in the context of advice from the QAA (2020), and statements from the Office for Students (2020) on what type of activities are acceptable.

Cases of Practice

In this section we share five adaptations from colleagues across the sector that relate how they have responded to the disruption COVID-19 has presented to the development and assessment of practical skills. **Jos Darling** (University of Bath) developed Racing Academy 2, a computer-based car drag race game that supports the teaching of first-year engineering dynamics in the absence of laboratory experiments. **Voicu Ion Sucala** and **Sean Carroll** (University of Exeter) developed a structured process to critically review all practical activities according to their contribution to AHEP learning outcomes, developing different response strategies for different types of contributions. **Fiona Gleed** (University of Exeter) used a number of strategies and a holistic approach to pivot a partially completed design-build-test project for civil engineering degree apprentices. **Thomas Baker** and **Marcia Milan's** (University of Hertfordshire) 'skateboard assembly line' made innovative use of video in a lab environment. **James Atkinson**, **Thomas Popham** and **Claire Lucas** (University of Warwick) pivoted to a self-paced online course with a range of support technologies to replace the existing on-campus computing laboratories. We hope these cases offer encouragement, reassurance and inspiration; do get in touch with the contacts if you would like to hear more.

Case Study 3.1
Jos Darling
University of Bath

What was your innovation and its context?
Engineering is a practical subject that benefits from the hands-on experience of physical systems. Unfortunately, social distancing makes conventional laboratory experiments difficult to undertake, so *Racing Academy 2*, a computer-based car drag race game has been developed to support the teaching of first-year Engineering Dynamics. Players are required to compete in a car drag race against an AI opponent, selecting a chassis, engine, tyres, and gear ratios for their vehicle. The player's customised car races against a virtual opponent, and additional features are unlocked as they progress through the game. The effect of both driving style and vehicle design can be viewed and analysed using the graphical output of vehicle velocity versus time. In this way, students can see the effects of their choices, interventions, and actions. The intention is to develop a set of instructions to be followed by the player, so that the physical effect of engine torque, vehicle mass, tyre friction, and gear changes can be illustrated through graphical output. This will enable the student to write a 'laboratory' report that can be assessed. At the completion of the exercise we intend to hold a virtual 'Grand Prix' in which the top players compete against each other.

What were the positive things about the change?
Video games are increasingly being adopted as a teaching method at all levels of education as they enhance traditional educational tools and motivate students to repeat techniques without barriers to learning such as embarrassment or boredom. In this instance, the on-line game will enable all our students to undertake the exercise at the same time, rather than a lab with social distancing that would take a period of several months to complete – we have a first-year cohort of 250+ students. It is hoped that this game will improve the engagement between the students and their tutors, giving them a focus for the early period of their degree. The 'Grand Prix' will provide a climax for the exercise and enable the gaming enthusiasts to optimise their vehicle and driving technique. The game was written by a final year engineering student and we intend to make it free to other institutions.

What was challenging/less effective about the change?
Video games provide an educational experience that enhances the curriculum, but they are not a direct replacement for practical hands-on activities and it would be wrong to think otherwise. Not all students are keen gamers, and

it is thought that female students are less inclined to play computer games. Likewise, not all academic staff see the benefit of educational games, and argue that the 'experiment' is sufficiently different from a practical laboratory exercise to make it difficult to write up in a traditional format. The game has been designed to operate with a low cost PC, and has simple controls, but some students are more adept at gaming than others and it may be that some students are disadvantaged by their limited coordination.

What advice would you give to colleagues interested in implementing or building on your innovation?
We are keen for other institutions to use our software in their own teaching of Engineering Dynamics. Depending on when the exercise is introduced, it may be necessary to give an on-line lecture that explains the important dynamics involved in vehicle acceleration – torque, gear ratios, tyre friction, vehicle mass, and aerodynamics. In order to ensure that the students gain the expected learning outcomes from the exercise, it is important that there is a worksheet to guide them through the various stages, and stop them proceeding without 'reading the instructions'.

Case Study 3.2
Voicu Ion Sucala & Sean Carroll
University of Exeter

What was your innovation and its context?
All scenarios for the next academic year include the assumption that some social distancing rules will exist. They will impact the infrastructure capacity, so moving as much content as possible online is the obvious solution. However, this is not always possible especially in the case of laboratory and workshop sessions which provide training essential to meet the accreditation requirements. At Exeter we're using an innovative procedure of planning all practical activities for 2020-21. By analysing each programme's AHEP learning outcomes (LO) mapping, all critical learning outcomes (CLOs) requiring a practical activity are identified. This is followed by tracking of all activities delivering these CLOs, at module level. These activities are then checked against the expected delivery capacity. If there will be sufficient capacity, the activity remains as it. If the capacity is challenging, a decision is made depending if the corresponding CLO was or will be delivered elsewhere in the programme. If the answer is positive, the activity is removed from next year's delivery plan. If the answer is negative, the essential activity will either be replaced by an online alternative, delayed, or

moved into a different module and stage. Finally all these changes are recorded for each stage of each programme.

What were the positive things about the change?

The main benefit of the procedure is that it provides a clear roadmap for planning the next year's delivery in a blended way that also complies with the professional engineering institutions' (PEI) accreditation requirement to deliver and assess each LO. It also provides a monitoring tool which will record all changes and therefore will facilitate reporting to PEIs. The procedure takes into consideration the fact that each stage becomes a standalone variation of the programme and therefore it needs to be monitored separately. At the department level the procedure is ensuring the delivery and assessment of all required learning outcomes (LO) in a robust and feasible manner across all programmes and stages. Another, perhaps less visible, benefit is that the procedure requires all academics to look at programme rather than modules' learning outcomes; therefore it emphasises what students acquire in a holistic, rather than detailed, manner for their education journey.

What was challenging/less effective about the change?

The most important challenge faced while implementing this procedure has been the complexity of recording and monitoring the AHEP intended learning outcomes for all programmes and all stages. Considering that at the University of Exeter we have 6 families of programmes (for example, mechanical, civil engineering), each one with multiple variants (BEng, MEng, with Study Abroad, with Industrial Placement, etc.), and each year of study is affected by the current crisis, the number of groups of students (a specific programme in a specific year of study) in need of monitoring of the learning outcomes over the next academic year rapidly escalates in the range of hundreds. It is crucial to be able to properly record all changes, for each programme and stage, so further reporting will be possible in an effective and efficient way. This process should be done by the accreditation team, and using specialised software is the most feasible approach to this.

What advice would you give to colleagues interested in implementing or building on your innovation?

There are several pieces of advice we'd consider useful. First, it is crucial to make the college and the university aware of the specific accreditation challenges faced by the engineering programmes. Second, the top down approach (programme – module – activity) is key for successful management of the delivery and assessment in the upcoming years. It is the programme-

level at which the entire procedure must begin and must be completed. While it appears to be easier to make the analysis and decisions at the module level, it is the programme that is accredited and is subject to assessment by the PEIs.

Case Study 3.3
Fiona Gleed
University of Exeter

What was your innovation and its context?

In March 2020, the University of Exeter campus was closed as part of the UK response to COVID-19, requiring the final residential block of our Civil Engineering Degree Apprenticeship to be taught remotely. The first year cohort was completing a group design, build, test (DBT) project, a particular challenge to pivot at short notice. The original assignments of a laboratory log and a group presentation were replaced with a structured study topic on risk assessment and a group portfolio. An individual reflective report was retained to close out the project and module. One of the intended learning outcomes (ILO) specifically required 'practical work in an engineering laboratory', making it impossible to assess remotely. A second ILO, requiring a presentation, could have been retained but would have diverted students away from the design task to mastering specific digital tools. Deferring these ILOs to a future module allowed me to focus on the broader aim of the module, prioritising engagement with the design process, and recognising the effort that groups had already put into their conceptual design work. I also wanted to support the students with adjusting to remote learning and developing their own resilience.

What were the positive things about the change?

The structured study topic worked well, allowing me to introduce a broad range of risks from the students' own working environments, through to national pandemic preparedness and sustainable development goals. These will have a positive impact on their approach to project work over the next four years of the apprenticeship. Facilitating students to risk-assess their own remote working set up, including identifying their support network of peers and mentors, encouraged them to be proactive in making improvements. Short answers at the end of each section based on individual circumstances, rewarded completion and provided evidence of the need for lecturers to limit the duration of synchronous activities. Submission deadlines were revised to ensure that students received feedback on the topic and group portfolio ahead of their final submission of an individual

reflective report. I was then able to provide a further response, acknowledging the issues raised and recognising their resilience.

What was challenging/less effective about the change?

As groups had prioritised different tasks from the original brief, I set a flexible format for the portfolio to maximise the credit for work already completed prior to remote learning. The submissions used diverse approaches but none was easy to mark asynchronously on a small-screen laptop. Marking was only achievable as the group submission reduced the total number of portfolios to work through. In future, I would ask students to include an index identifying evidence for specific assessment criteria. This approach could also have emphasised the importance of the criteria within the overall brief. It was very challenging to write a study topic in real time, with installments released daily, and I was only able to run a couple of synchronous tutorials each week. Cohort coffee breaks with several lecturers present might have been a more efficient way to catch up on immediate issues across a range of modules.

What advice would you give to colleagues interested in implementing or building on your innovation?

Short responses based on individual enquiry were very effective, providing an opportunity for immediate feedback, and helping students to structure their reflective reports. I know my students will need frequent screen breaks, value practical activities, and want opportunities to present their work. I will be taking a resilient approach to the project next year, with a build that can be completed outside the laboratory, and presentations in the Institution of Civil Engineers' Pitch 200 format. The competition runs annually so students will be able to share their work to a wider audience, or apply their digital skills to another topic.

Case Study 3.4
Thomas Baker & Marcia Milan
University of Hertfordshire

What was your innovation and its context?

The *Lean Manufacturing and Services* module at the University of Hertfordshire gives students the chance to design and physically build an assembly line, using skateboards as a product. Part of this activity is using time-motion studies, where students assemble a skateboard and make detailed time and motion analyses, using video footage of the assembly process taken on their

Figure 3.1: Video footage of the skateboard assembly process

mobile phones. Most of the labs for the module had been completed before the COVID-19 outbreak, and students had the benefit of the activities planned. However, the closure of the campus meant that it will not be possible to hold similar laboratories for students who needed to resit the assessment in the summer, therefore requiring an alternative assessment. The solution lay in using video footage of the skateboard assembly process (Figure 3.1) as the basis for the assessment (an approach also used in industry during the COVID-19 crisis by leading consulting companies (e.g. Kaizen Institute)). This allowed students to do the same time-motion analysis as if they'd done the labs, and participate in a meaningful, authentic assessment.

What were the positive things about the change?
First, the work submitted by students for the resits assessment was of a comparable standard and rigour to that of students who had done the lab physically. However, possibly the biggest benefit was in the planning for next academic year: while the number of students requiring resits was relatively small, it proved a useful development ground for the environment we will face in the coming academic year, where lab activities will be restricted or impossible. Thus, this video footage will form the basis of the 'practical' assessment for next year's modules, where students will have the opportunity to do the time-motion studies without having physically attended the lab

sessions. This technique is transferable to any lab where measurements are needed as part of the lab assessment: indeed, this approach will be used across the school in the next academic year to provide alternate 'lab' sessions while we navigate the COVID-19 situation.

What was challenging/less effective about the change?
Unfortunately, video will never be an authentic replacement for the tactile learning that occurs in doing a physical laboratory, and the limitations of a video 'lab replacement' need to be recognised when setting the assessment. For example, it may be necessary to state which tools are needed for a particular task in a video 'lab assessment', as students won't have the opportunity to intuitively discover this for themselves as they would in a lab. Second, it is important to obtain the appropriate permission from anyone appearing in a video for footage for the video to be used in this way. Third, it is important to introduce a series of formative submissions to monitor that students are interpreting the information in the correct manner. The risk is that a purely video-based lab can induce students to make assumptions that aren't realistic or suitable in the real world.

What advice would you give to colleagues interested in implementing or building on your innovation?
It will greatly help students if you do a narrated 'demonstration' video, where you verbally narrate instructions as the video plays, directing students as to what they should be looking for, and what they should be measuring on the video. This can be done on alternate footage of the activity or on a limited portion of the actual footage they will be using. If you do narrate your demonstration, don't forget to include subtitle captions as required by updated accessibility requirements.

Case Study 3.5
James Atkinson, Thomas Popham & Claire Lucas
University of Warwick

What was your innovation and its context?
Our usual approach to computing laboratories is to have repeat sessions delivered over a single week (in large computer rooms) during which students follow a prepared worksheet. Our largest sessions are delivered to 90 students with 1 academic and 3 postgraduate students providing support. During Covid-19 we developed an equivalent, self-paced online course using a variety

of technologies to offer effective support. We recorded short instructional videos to introduce high-level concepts, and used detailed MATLAB live scripts to explain tasks, provide examples and communicate learning objectives. Students had deliverables for each section, which were uploaded at the end of the course and auto-marked using test scripts to provide feedback to the marker. Students were able to choose a preferred method to access support, including bookable 15-minute video conferencing slots, with screen sharing used to facilitate support for checking code. Students also made use of chat functions to ask simple follow-up questions or to support one another. Importantly, it was the combination of mechanisms which we found worked well, allowing students to select a method of support that worked for them.

What were the positive things about the change?
We experienced strong student engagement with the course (indicated by Moodle analytics), despite the disruption caused by the online transition. Clearly presenting and carefully structuring the course resources on Moodle allowed students to effectively plan their approach and to allocate time effectively. Using videos adds variety, improves engagement and offers a personal touch in the absence of face-to-face teaching. We obtained a large amount of student feedback via Moodle, with 80% of students rating the online course as good or excellent. Some students preferred the online support offered compared to sometimes having to wait for questions to be answered in a busy lab. This was especially true when considering simple bugs and programming errors, which are easily solved but can cause long delays for students. In future, the use of test scripts could be expanded to improve the experience for students and to support them as they learn to debug their own code.

What was challenging/less effective about the change?
The teaching of programming to large cohorts with varying skill levels is always challenging. The main challenge was therefore offering the required level of scaffolding in the preparation of the course, ensuring that all students were able to engage with the learning despite varied starting points. Some students found it difficult to self-motivate to get started on the course because the deliverables for each section were all due at the end; this could be solved in future by setting deadlines for each part. Finally, MATLAB required add-ons for some of the learning problems which are pre-installed on lab computers. This resulted in some disruption for students who needed to install them at home and instructions for doing this needed to be provided. We encouraged students to utilise MATLAB online instead of the desktop version where their

own equipment wasn't suitable, the platform proves very promising for the future.

What advice would you give to colleagues interested in implementing or building on your innovation?
The need to produce resources to support students with varied programming experience was further emphasised by the transition to an online course. We advise colleagues to: break tasks down into shorter sections and allow students to track their progress (Moodle allows you to 'tick' sections when complete); use small deliverables and provide test scripts to help students debug their own code; provide different ways of accessing individual support, including bookable video calling and open chat; and explore online platforms for coding (rather than relying on installed software) to help prevent technological issues for students.

Student Perspectives

Throughout this section, student surnames refer to the student perspectives presented alphabetically by surname in Part 2 of this volume.

Future activity of the network clearly needs to address the demands and concerns of students that have been impacted by the adjustments made. From the students' reflections, it is clear that they appreciate the effort that staff put in, for example Vasudev commented that 'maximum effort was made by the university to make the experience similar. Hats off to the lab assistants for making this possible.' However, despite liking the change, students questioned the value for money this new form of instruction provided: 'What would you like your lecturers to consider if they were adopting this change in the longer term?' – 'I would totally abide by it, as long as my tuition fee is reduced from £22k. I like it this way as you can work at your own pace but still have the pressure of getting things done.'

There is no doubt that students felt heavily impacted by the lack of access to physical laboratory classes, although they also drew some positives from the experience. 'The lab sessions, the laboratory team of the University were really amazing to provide all the sessions through online mediums but the core essence of a lab is lost during the same process, exercising it by hand makes it more intuitive and provides a far greater learning experience when compared to online labs.'

Abboushi commented, 'Online recorded practicals where the lecturer

records/streams themselves doing the practicals which we would have done ourselves. This could be a great way to learn as the lecturer slowly goes through the steps we would. As practicals are sometimes disorganised when left to our own devices, this could even be an improvement upon them.' However, they also reflected that practical experience in group research projects was not so easy to replace: 'The main issue was losing out on practical experience. I was completing my Master's, which involved a team research project, where we would have had to physically fabricate our designs. This was not possible so we missed out on the lessons learned in that practical experience.'

This was echoed by Hwang: 'The least enjoyable aspect of online teaching was the complete lack of experimental laboratory work. All laboratory work for both my project and modules was cancelled. Frustratingly, I had insufficient data to complete my project and was provided with mock data for my modules' coursework'. Another student commented that 'For modules that require group projects and labs, the experience with these assessments will be significantly affected. Discussing technical stuff online is quite difficult in my opinion. Doing lab assignments without actually doing the lab is confusing and provides limited value and learning experience.'

Others questioned if replacements are possible: Casadei, 'I am an interactive learner, so for me there is no replacement for practical lab activities. I feel like the replacement options were suitable to demonstrate the key knowledge – mostly just showing the applications of what we learned in lectures – but normally in labs, something 'clicks' while doing the activity, and cements the lecture content. This doesn't seem to happen with replacement labs.'

These reflections suggest that although some of the shorter timescale laboratories may be able to be replaced and even improved online, the practical design or research project is far more difficult to replace. Although these students have experienced disruption in the face of an emergency event, the expectation that projects involve physical experimentation or prototyping is common, and if restrictions mean that students are required to undertake paper- or simulation-based projects, it is likely to leave a significant group of students dissatisfied.

References

Chiu, D. M., & Chiu, S. Y. (2004) An open-ended laboratory system with computer-aided simulation for undergraduate electronic engineering. *International Journal of Engineering Education*, 1(6), 193-197.

Domin, D. S. (1999) A review of laboratory instruction styles. *Journal of*

chemical education, 76(4), 543-547.

Garrard, A. (2020) 'How do we think about labs in an online context?' *Educating Engineers: Lasting Impact From Crisis Innovation*. York: Advance HE Connect. [Webinar, 2 June 2020].

Garrard, A., Bates, J., Beck, S., & Funnell, A. Codifying an Approach to Remote Practicals. *Preprints* 2020, 2020060182 (doi: 10.20944/preprints202006.0182.v1)

Gomes, L., & Bogosyan, S. (2009) Current trends in remote laboratories. *IEEE Transactions on industrial electronics*, 56(12), 4744-4756.

Loro, F. G., Macho, A., Sancristobal, E., Artacho, M. R., Díaz, G., & Castro, M. (2016) Remote laboratories for electronics and new steps in learning process integration. *In* 13th International Conference on Remote Engineering and Virtual Instrumentation (REV) (pp. 112-117). IEEE.

Office for Students (2020) *Guidance for providers about quality and standards during coronavirus (COVID-19) pandemic.* Available at: www.officeforstudents.org.uk/media/f351a739-6cd6-4310-8f98-a6aa603f17f4/quality-and-standards-guidance-during-coronavirus.pdf.

QAA (2020) *Lab and practice based assessment.* Available at: www.qaa.ac.uk/docs/qaa/guidance/covid-19-thematic-guidance-practice-lab-based-assessment.pdf.

Rahman, N. A., Kofli, N. T., Takriff, M. S., & Abdullah, S. R. S. (2011). Comparative study between open ended laboratory and traditional laboratory. *In* 2011 IEEE Global Engineering Education Conference (EDUCON) (pp. 40-44). IEEE.

Rivera, L. F. Z., & Petrie, M. M. L. (2016). Models of collaborative remote laboratories and integration with learning environments. *International Journal of Online and Biomedical Engineering*, 12(09), 14-21.

Roach K., Tilley E. & Mitchell J.E. (2018) How authentic does authentic learning have to be?, *Higher Education Pedagogies*, 3(1), 495-509.

What does moving online mean for employability?

Gary C Wood
University of Sheffield

• •

This chapter takes employability as its central concern, recognising that engineering is a vocational discipline. It establishes that students consider their employability to come from opportunities outside the core curriculum through activity that has been severely disrupted as students have dispersed within and away from University buildings because of COVID-19 public health measures. Its call to action asks us to support this critical aspect of student development even in the midst of crisis. Colleagues are invited to build alternative pathways to employability by enhancing industrial projects, deploying more developmental assessment formats, helping students map their own employability, strengthening relationships with support services, empowering students with new communication technologies, and taking advantage of a virtual location through more ambitious collaborations across modules, departments, institutions and regions.

Engineering is a vocational discipline and it is therefore vital that engineering educators consider employability as a crucial part of learning and programme design. Yorke (2004) defines employability as 'a set of [capabilities] – skills, understandings and personal attributes – that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy.' Whilst this definition focuses on graduates, a focus on employability directly benefits continuing students and our course outcomes, because the capabilities required for employment also make students more effective at studying.

Specifications of the skills and knowledge required by engineering graduates vary, but are generally underpinned by AHEP3, to include:

science and mathematics; analysis and design; context and impact; practical skills; and professional capabilities, including problem-solving, communication, working with others, information literacy, IT skills, self-direction and commitment to CPD, initiative, personal responsibility and leadership, and project management (Engineering Council, 2014).

In spite of these long-standing specifications, there is abundant evidence that higher education is missing the mark when it comes to equipping graduates for life as professional engineers (Royal Academy of Engineering, 2010; Markes, 2011; IET, 2014, 2019; Winberg et al., 2020). A longitudinal picture is presented bi-annually by the IET's Skills and Demand in Industry reports. The 2014 survey indicated that 42% of companies found graduates to be lacking in workplace and professional skills – including leadership, communication and literacy; working on their own initiative; numeracy; and teamwork – increasing to 59% by 2019 (IET, 2014, 2019). The 2017 survey reports that 46% found graduates lack relevant technical skills, rising to 57% by 2019. In other words, a majority of employers do not find gradautes have relevant workplace or technical skills on joining, and this situation is getting worse. One positive amongst the IET's survey results is that, in 2019, 81% of employers recognised their responsibility to support transitions from education and training into the workplace. This is important, for as Baytiyeh & Naja (2012) note, studying in a University can never teach students about a work environment, even if it addresses skills and knowledge.

The importance of industry involvement in education is further highlighted by the results of our poll that informed the *Lasting Impact in Crisis Innovation* webinar on employability (Wood, Findlay and Resalat, 2020). Engineering students were asked which of five activities at university has the greatest influence on their employability. Responses (n=118) reveal that over 65.3% of students think internships, placements and volunteering matter most, followed by 25.4% who suggest that extra-curricular activities in engineering have the most impact. Of particular note is that only 2.5% of students reported that their course was the most important factor (Figure 4.1). Although the poll did not further probe students' responses, anecdotal evidence and experience of students securing placements suggests that they view the degree as the first checkbox on recruiters' checklist: it's a necessary but not differentiating condition to secure graduate employment.

The changes to learning and teaching, and to workplaces, as a result of COVID-19 have impacted on the usual ways we might develop students' employability. An immediate concern is that the two activities engineering students value the most for their employability – internships and engineering extracurricular activities – are the things that have been lost as we have

65.3% Internships, Placements & Volunteering
25.4% Extracurricular activities in engineering
3.4% Extracurricular activities outside engineering
3.4% Careers Service, employers on campus, etc.
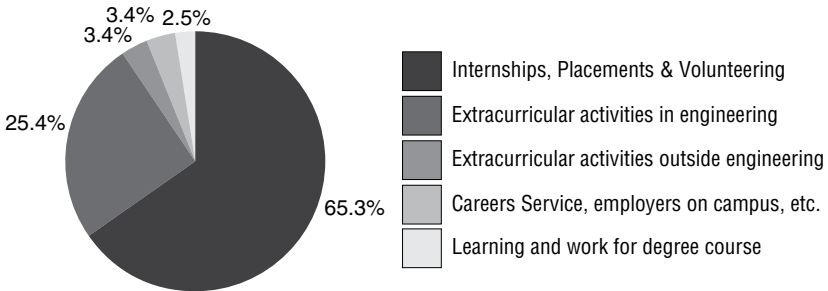2.5% Learning and work for degree course

Figure 4.1: Poll results for Engineering Students: 'Which activity at university has the greatest influence on your employability?' (Wood, Findlay & Resalat, 2020)

pivoted online. Internships are the opportunity furthest from our direct control as engineering educators, because they are facilitated and delivered by our colleagues in industry; and traditionally, extracurricular provision has been student-led, practical, and relient on campus-based face-to-face activity, meaning that it has all but stopped. The loss of internships is particularly detrimental, because they are recognised as being one of the most important factors in helping students to work independently and make decisions in an engineering context (Magolda, 1996; Wakeham, 2016).

We might hope that gaps left by these activities can be attended to through the curriculum, but 42.8% of participants in our *Lasting Impact* webinar series reported not having taken any action to support students' employability in the three months since we entered lockdown. Engineering education practitioners' priorities have been core teaching: making sure learning outcomes that normally rely on practical and laboratory-based activity could be met; that students working in teams could complete their projects; and that assessment was adapted at speed to ensure robust and reliable measures of students' learning, and enable their progression.

Nevertheless, on reflection, our new ways of teaching have created different opportunities to enhance employability. Students have had to use video conferencing and other online communication and collaboration tools to engage with learning and present their work. They have been working more independently, and so have needed to adapt to managing and structuring their own time (Wood, 2020b). They have had to deal with uncertainty, being adaptable and resilient, as plans have changed rapidly, and they have prepared for exams and assessments without initially knowing exactly what format they would take. Collaboration has been across space and time, often

becoming asynchronous as members of project teams have returned to their home countries and completed work internationally (see Bass, McDermott, & Lalchandani, 2015). We have also seen collaboration across hierarchies, as students have been more involved in co-design of curricula, learning experiences and activities, working in partnership with academic staff (see Chapter 5). Diversity in the student population has become more evident than ever before, as international students, mature students, students with additional needs or responsibilities have been working from home, in environments that make those differences more visible to their peers. Creativity and personal development have been promoted through students finding ways to fill their time when they cannot take up placements and internships.

Even as a non-exhaustive list, the preceding paragraph makes evident a host of employability learning opportunities that have become available through new ways of working. A risk is that students do not recognise, and therefore are not able to articulate this learning and the skills it has fostered, since we know that students' ability to articulate their skills is often lacking at the best of times (Tomasson Goodwin et al., 2019).

As disruption to normal life continues and we extend our new approaches into the next academic year, attending to students' employability must be of greater importance to engineering educators than ever before. We need to ensure that the learning experiences we provide for students are infused with opportunities for them to develop workplace-ready skills, and find opportunities to do that in authentic contexts. Responding to this challenge might involve:

- **calling on industry to realise its commitment to supporting education**, reported by the IET (2019), by engaging our students in real-life projects, or providing students with industry mentors; or adapting work so that learning is explicitly and more readily linked to applications of knowledge and approaches in engineering practice, rather than it remaining purely theoretical. In so doing, a key consideration is to ensure that students work on open-ended, unstructured problems: as Baytiyeh & Naja (2012: 4) note, 'engineering students complete a highly structured curriculum, but a professional engineer works in a highly unstructured environment and performs multi-dimensional tasks'.
- **thinking again about the learning activities and assessment formats** we have chosen, and the briefs they set for students, so that the range of skills developed is broad across the programme. A key question is what opportunities there are for different tasks to facilitate learning of technical knowledge whilst also building students skills

in collaboration, communication, analysis, problem-solving, design, information literacy, IT skills, project management, and opportunity to demonstrate initiative, personal responsibility and leadership. Seeking support in your institution to help students learn and develop these skills – rather than relying on a learning by doing philosophy – is crucial to success.

- **making explicit to students the skills and experiences we have embedded**, and the choices we have made to include them, whilst supporting students to reflect on their own learning so that they are able to recognise, articulate and exemplify their (developing) capabilities for themselves. This need to be linked to their understanding of, and commitment to, their own self-direction and commitment to continued professional development.

- **signposting students to services and additional support within our institutions** – such as a careers service, academic skills centre, students' union – where they can develop skills and explore their options for life after graduation. Importantly, we must not rely on students to engage with wider provision around their degree – it is not sufficient to cover employability by pointing to a careers service: it should be a holistic part of students' development through their course.

- **thinking beyond our own practice, to empower students to support themselves.** We need to equip and support students to utilise the technologies for online delivery with which we are rapidly becoming familiar. Doing so will enable them to facilitate more independent, student-led learning on an extra-curricular basis (as well as creating opportunities for us to learn about how they best learn in this new environment, and so to adapt and evaluate our own teaching practices).

- **considering opportunities to collaborate within and across departments** and programme teams to offer joined-up learning experiences that allow students to integrate and apply learning in a wider context than an individual module permits.

Whatever we do, it is likely we will be operating in an increasingly competitive environment, with fewer students, and therefore fewer resources available. To successfully navigate the challenges ahead, it is imperative that we are attuned and attend to the needs of our students in the longer term, beyond our classes and the contribution of our individual modules to their journey. Our future success as institutions, their success as engineers in training,

and the collective success of the engineering profession and UK's economy depends on the decisions we make to support students' holistic development towards professional practice in the coming months.

Network Activity

The *Lasting Impact from Crisis Innovation* webinar, *What does moving online mean for employability?* assessed network participants' thinking about employability throughout the initial COVID-19 transition period, from March-early June 2020. We asked to what extent participants had been thinking about employability in transitioning their teaching online. From a mixed audience of both engineering education practitioners and professional staff working with engineers, some of whom had a careers and employability focus to their roles, results indicated that: 22.9% of participants had seen employability as a priority; 34.3% had considered it and taken some action; 25.7 % had considered employability but not taken any action; and 17.1% had not considered it at all. Given the importance of employability outlined thus far in this chapter, these findings point to a need for greater consideration and focus on employability as part of planning for sustained online delivery moving into the 2020-21 academic year.

It was encouraging to note that when asked what kinds of activities participants had used in their practice to build students' employability prior to the pandemic, a wide range of approaches was shared. Examples included: using group projects with varying levels of structure, sometimes with industry engagement as mentors or clients, or open-ended, messy problems; industrial placements and internships; engaging guest speakers from industry in class; industry consultation in curriculum design, to ensure relevance; embedding transferable skills, for example in leadership and programming, into modules; offering mock interviews for students; and developing reflection skills. Only two activities offered in response to this question explicitly mentioned digital skills, including using collaborative tools in VLEs and running webinars, indicating the extent to which we need to shift thinking as we adapt to digital delivery of learning and teaching.

After hearing from students, who shared their experiences of the effects of the pandemic on their employability in and around the curriculum, and during a year in industry placement (see case studies from Findlay and Resalat, in Part 2 of this volume), we explored immediate ideas for enhancing students' employability as we continue to develop our practice online. The full list of suggestions submitted is available in the Pioneering Programmes and

Practice in Engineering Education Advance HE Connect network, with key themes including:

- **Project learning activities and assessments** – Using authentic or real projects, with open-ended briefs and conflicting constraints; linking with industry or community groups; modelling workplace structures and approaches, including agile daily check-ins; and integrating projects vertically so that students from different years, and with different knowledge, work together.

- **Outreach, engagement and collaboration** – Having students complete outreach and engagement activity, such as organising conferences or seminars online, and bringing in external participants; working across academic departments, for example asking media students to direct engineers producing video presentations; using virtual collaboration tools across space and time; building in social meet-ups to build teams; and partnering with academic teams in other countries to solve problems with a community stakeholder.

- **Creative/digital media** – Using creative/digital media for presentation of work, for example narrated slides to replace live presentations, cohort blogs, creating videos for specific themes and audiences; using digital collaboration tools such as Google Docs, Microsoft 365, and video conferencing software; creating virtual rooms for students in VLEs; and providing low-cost kit to students to use at home, e.g. Arduinos, Raspberry Pis.

- **Embedding skills** – Building professional capabilities into activities as part of the learning experience, for example communication and negotiation skills, giving and receiving feedback and constructive criticism; encouraging departments to weave a thread of skills development and reflection across their programmes; supporting students with time and workload management, and linking this to workplace behaviours; offering seminars and workshops on skills, perhaps in concert with professional services supporting academic skills development; building in opportunities for students to reflect, during classes and through personal tutorials, and helping them to start using this skill independently, selecting their own stimuli for reflection (Gibbs and Wood, 2019).

- **Industry input and exposure** – Replace on-campus input with videos, virtual tours, etc; invite speakers from industry as guest lecturers, or contributors to help frame the relevance of learning – which may be easier to organise for shorter presentation slots, if delivered online without the need to travel; involve industry in setting, supporting

and reviewing students' work; virtual industry events; and engaging students with conferences in the discipline – costs will be free or much lower for virtual than events that require travel.

Although this list is not exhaustive – no list could be – it results from around fifteen minutes of brainstorming in the webinar. Clearly, some ideas in the list would take more time to establish than others, but it is nevertheless encouraging to see that there are many possibilities, and at least some of them can be implemented with minimal change to existing plans. What remains crucially important is helping students to recognise, evidence, and articulate their learning of professional skills, and not just the theoretical content of their learning.

Cases of Practice

In this section we share four approaches to employability in times of COVID-19 from a range of stakeholders. **Tejal Fatania** (University of Warwick) revitalised the use of learning logs for reflection and deep learning on the part of students. The author, **Gary C Wood** (University of Sheffield) found his innovative final year *Preparation for Practice* module, in which students undertake an individual development activity, to be notably resilient to disruption. **Stacey Mottershaw** (University of Leeds) reflects on the value of personal tutoring to support students' employability with many transferable lessons from her recent work with business students. **Annette Baxter** (University of Sheffield Careers Service) explains how careers provision has been adapted to continue supporting students effectively. **Marie Smart** (Meggitt) provides an employer's perspective, explaining how the company has adapted from traditoinally attending on-campus careers fairs to an approach based on strengthening long term relationships with universities as well as holding their own virtual events. We hope these cases offer encouragement, reassurance and inspiration; do get in touch with the contacts if you would like to hear more.

Case Study 4.1
Tejal Fatania
University of Warwick

What was your innovation and its context?
We reinvigorated and reimagined learning logs for use in online engineering

seminars, in order to promote reflexivity and deep learning. Learning logs were carefully designed in a student-centred and non-bureaucratic way, with three sections: observations about the material; implications of the material; and questions about the material. Students were asked to complete learning logs as part of pre-work for interactive online seminar sessions. They also completed learning logs, which were shared with the tutors in good time prior to the sessions. This enabled tutors to incorporate real learning and student questions into subsequent synchronous online sessions. This was in the context of the need to rapidly re-develop a large module for online delivery at WMG, the University of Warwick, during the COVID-19 outbreak.

What were the positive things about the change?
Learning logs enabled students to reflect and engage with course material, which helped promote rich and critical discussion in subsequent online seminars delivered to groups of up to six students. This enabled specific elements of learning to be teased out, and built upon in the substantive sessions, by tutors in a safe learning environment. Students have subsequently provided positive feedback on how this approach has prepared them for the online learning seminars and how it has promoted thought, understanding and reflection.

What was challenging/less effective about the change?
Communicating the change was challenging, as students were accustomed to face-to-face delivery with much less pre-work. Tutors communicated pre-work requirements to students a week before the running of each online module, in order to allow students sufficient time to digest and complete the required work. The virtual learning environment also needed to be quickly adapted and updated in order to accommodate the new material. The administration team faced the challenge of providing student information to tutors much earlier than usual, in order for students to be organised into appropriate seminar groups and to be written to by tutors.

What advice would you give to colleagues interested in implementing or building on your innovation?
Carefully design learning logs in order to make them attractive to students. The learning logs which were utilised had a number of distinct sections with different requirements. Communicating the importance, and utility, of the learning logs was also critical in order to promote buy in and therefore completion.

Case Study 4.2
Gary C Wood
University of Sheffield

What was your innovation and its context?
In the 2019-20 academic year, we began the introduction of an embedded spine of professional capability development within our Mechanical Engineering MEng programme. The spine enables students to develop professional skills including communication, collaboration, individual effectiveness and self-awareness, information literacy and enterprise capability, delivering training just in time before students need to use these skills in integrative projects throughout their learning experience. One of the most important underpinnings of employability in our MEng programmes is the preparing final year students for their transition to professional life. The final year of our skills spine is delivered through a 15-credit module, *Preparation for Practice*, with three broad aims:

1. to equip and enable students to take responsibility for their own development, by choosing, undertaking, and reflecting on 100-hours of independent development aligned with their career aspirations;
2. to enable students to reflect on their profile as a graduating engineer, through creating a reflective portfolio evidencing their capabilities; and
3. to build students' awareness of their professional responsibilities as an engineer.

Students have an academic year to complete this work, so that they take responsibility for planning and working independently, supported by a mentor who they can consult for advice and guidance.

What were the positive things about the change?
The 100-hours of independent learning enables students to pursue knowledge and skills that they select based on their career plans, and so they cover a diverse range of learning, from enhancing CAD skills or learning programming, through to communication and collaboration skills, and developing foreign language abilities. Making their choices requires students to reflect, and prompts them to identify their strengths and weaknesses in the context of their career aspirations, whilst enabling them to demonstrate commitment to their own development – useful for job applications, and also in building skills to manage CPD as a lifelong learner. The independent learning model also made this module resilient in the face of COVID-19 disruption: the portfolio assessment format did not need to change, and adapting mentoring and drop-in sessions to run online was straightforward, increasing engagement from

some students (Wood, 2020a).

What was challenging/less effective about the change?
In the first half of the academic year, before COVID-19 disruption, we found a significant number of students were initially uncomfortable about making a choice of what to work on for their 100 hours. It was not that they did not have ideas; rather that they felt the need to seek permission to respond to the needs they identified, rather than taking responsibility themselves. Effective support for students is therefore really important, and this will be enhanced for us in future years as the skills spine becomes embedded across earlier years of the degree programme. When we transitioned online, we saw some challenges where students had been using specific software or technologies not available to them at home, which was ultimately resolved when our IT service made a remote desktop service available.[1] The truly independent nature of the learning experience also became more difficult for students as much of their time management became independent, without scheduled classes to provide some structure.

What advice would you give to colleagues interested in implementing or building on your innovation?
Allowing students to personalise their learning is rewarding: they responded very positively to it throughout, and in our endpoint evaluations. Students may ask for guidance or examples of what they can spend their independent learning hours doing – resist giving a list, because it becomes a menu and constrain students' thinking. Instead, support them to reflect: teach them to use reflective tools and encourage them to consider the specifications of some jobs, roles or graduate programmes they aspire towards to identify which requirements they'd least like to talk about in an interview. These approaches can help students to recognise their own development needs. Throughout, it is very important to ensure students have flexible access to support when they are learning independently (Wood, 2020a), so that they are able to seek advice and guidance when they need it. It is also helpful to ensure that the briefing for students enables them to understand the value of learning to manage their own development, as a key employability skill for their working life as they transition into roles as professional engineers.

---

[1] We were not made aware that students had difficulties accessing or using this service, and do know that it worked well for students with low bandwith Internet connections, but colleagues may wish to bear potential access issues in mind if adopting these strategies.

Case Study 4.3
Stacey Mottershaw
University of Leeds

What was your innovation and its context?

The innovation is twofold: the change in extra-curricular opportunities that students have been able to access, and how online tutoring has been effective based on our existing personal tutoring model.

Changing the dialogue – A key part of the personal tutoring approach at Leeds University Business School has always been to support student employability, something that has become more complex in recent months. Due to the pandemic, tutees have had limited access to their usual extra-curricular activities, such as part-time jobs, summer internships, and year-long placements. Students have demonstrated concern about the perceived 'pause' in their employability, and have sought additional reassurance and guidance from their tutors about how to continue to develop without these experiences to 'fall back on'. This has opened up a dialogue between tutors and tutees about the nature of employability, encouraging students to think critically and holistically about their skills development through less tangible activities.

Our personal tutoring model and online provision – We have specialist personal tutors who each take on between 60-100 personal tutees. This allows tutors to utilise and develop expertise in advising, as well as understanding and responding consistently to the complex needs of our students in ways that would not be possible in traditional tutoring models. This understanding has been especially important in the rapidly changing context of the COVID-19 pandemic, where tutors have been required to respond to a large number of (often very similar) queries.

Since our campus closed in March 2020, we have run our personal tutoring online. This is a relatively simple change, though I believe that our existing personal tutoring model provided us with a solid basis for this transition. Personal tutors very quickly became central to the University's plans to support students throughout the pandemic, and tutees saw us as their first point of contact during a time when they believed they had very few alternative ways to engage with the institution.

What were the positive things about the change?

An unexpected benefit of the pandemic has been the change of focus in conversations surrounding employability – necessitating students to look beyond the more obvious examples of employability (such as internships)

and encouraging them to reflect on other areas of skills development. For example, discussions have explored the different skills that the curriculum offers, such as research, analysis and attention to detail. We have also covered how the pandemic itself has offered students the chance to demonstrate their adaptability and resilience and their ability to persevere and succeed even when things do not go to plan.

Our personal tutoring model has provided us with a solid foundation for delivering tutorial provision during the pandemic and beyond. Online tutoring has given us far greater flexibility in setting up and running tutorial meetings, whilst also helping students to work on their digital literacy and communication skills in a professional yet informal environment.

What was challenging/less effective about the change?

Tutoring online has been largely successful, though there have been some instances where students have struggled to access institutional video conferencing software, such as Microsoft Teams or Zoom.

Whilst our personal tutorial model benefits, to a certain extent, from economies of scale, it can be incredibly time consuming for individual staff members to manage the needs of such a large number of tutees.

What advice would you give to colleagues interested in implementing or building on your innovation?

In the changing external context, consider how far your curriculum or institution relies on external activities to develop students' employability. Map skills development within your curricular and co-curricular activities, particularly if you haven't done this since the start of the pandemic – if you haven't considered the skills that students are developing during this time, it's unlikely that they will have done this themselves.

When tutoring online, be mindful of the digital literacy and confidence of your students – as well as their access to suitable technology. Be flexible and provide alternative options if needed.

Finally, reflect on how effective your personal tutorial model is – if it is inconsistent or dysfunctional during a 'normal' term, then it is unlikely to hold up well during a crisis. Whilst it might not be possible to overhaul your entire tutoring model over the coming months, there are measures that can be adapted in the short-term, such as offering group tutorials to encourage peer support (Calcagno, Walker and Grey, 2017) and ensuring that there is an equal focus on tutoring across all years of study (Grey and Osborne, 2020). You might also find it useful to explore resources via the UK Advising and Tutoring association (UKAT), which include the 'Top 10 Tips for Personal

Tutoring at a Distance' and 'Tutoring Students Online Using Technology' (UKAT, 2020).

Case Study 4.4
Annette Baxter
University of Sheffield Careers Service

As a Careers Service, our mission is to support students to develop their employability within their programme of study, through placement, work experience, and extracurricular activities.

From 18 March, when we started working from home, our priority was to collate the latest information on the impact of COVID-19 on the graduate job market, so we could provide relevant, timely and accurate updates to staff and students. These insights informed how we adapted our services. We created a COVID-19 and your Career FAQs guide, website page and webinar session to inform and reassure students, and to signpost to relevant resources such as information on virtual placement opportunities, ways to develop employability during the pandemic, and information on virtual recruitment and selection methods.

Within 24 hours we transferred all services to online delivery, offering support and advice for students and graduates via Google Meet, telephone or email. International students are a vibrant and significant part of the Sheffield community, and to address their needs, we offered early morning and evening opening times one day per week. We also introduced a 'Live Chat' system so we could respond to more enquiries than our existing appointment system allowed, and reach a wider cohort of students.

Our workshop and employer events programme continue online, including sessions to support students through the current situation, for example COVID-19 and Your Career, Video Interview Skills, and Virtual Assessment Centres, most of which involved graduate recruiters as co-presenters to ensure students were given credible and current insights.

Many of our engineering students secure vacation and year in industry placements, but these were amongst the first of the opportunities many graduate recruiters reduced or rescinded. Our employer engagement team is working hard to identify virtual internships, and other ways for students to engage with employers, to gain realistic work-based learning opportunities. We are developing some of these opportunities into digital learning pathways to increase reach across our student body. We have also taken steps to be more flexible so students can fulfil the assessment requirements for placements this

year; we usually expect placements to last 38 weeks, but reduced this to 24, and allowed placements to be completed within two different organisations if necessary.

The impact of the pandemic and loss of work experience placements may be felt especially hard by those from non-traditional or widening participation backgrounds. Consequently, we offered an Employability Opportunities Fund for students, to cover the expenses related to taking part in an alternative (potentially virtual) opportunity. The similar Postgraduate Research Experience Scheme was extended to PGR students to engage in employability-related activities during this lockdown period.

For the new semester we will be continuing with many of the virtual online remote services, supporting our academic departments to develop the employability and career readiness of their students, with online delivery, a pre-recorded suite of workshops and induction materials, virtual online career fairs, and employer networking events, to name a few.

What were the positive things about the change?
The transition to online delivery of our advice appointments for students and graduates was surprisingly smooth, with our service maintained seamlessly. This enabled us to extend our reach by providing appointments to students as far afield as Brazil, Japan and China, not just those in Sheffield! The extended opening hours haven't so far been taken up by students in different time zones, but by those with childcare responsibilities, part time jobs, and those wanting to make an early start to the day. Our service delivery has therefore extended beyond its anticipated target group, and we are meeting extra student demand. Early indications suggest that this will be something we will continue offering beyond the lockdown.

We have tried to be flexible and available to meet the needs of our different students at this difficult time and the webinars have been well received. Even during the typically quiet exam period during May, attendance at these webinars often higher than we would expect at that time of year. Having the recording of the session also provided a valuable resource for us to be able to refer students to 'on demand' – an added bonus we can benefit from.

What advice would you give to colleagues interested in implementing or building on your innovation?
Be brave; make the most of this time to initiate and try new initiatives. Be inclusive and mindful of addressing the needs of diverse student groups. Be responsive; the speed at which you adapt your services needs to be matched by creativity. And be positive – where there's a will, there's a way!

Case Study 4.5
Marie Smart
Meggitt

What was your innovation and its context?
The pandemic hasn't changed our approach with regards to recruiting graduates, as our graduate programme is an integral part of our talent plan. Our graduates deliver real value whilst on programme and become experts and leaders after the programme, so it's something we are dedicated to continuing. We have always recruited fairly small intakes, around 15 graduates globally each year, which allows us to deliver a personalised experience for all graduates. This has meant we've been able to commit to our 2020 offers and look forward to recruiting our 2021 intake, despite the challenges the pandemic has created.

Before the pandemic, one of the key ways we'd attract potential candidates was through careers fairs held by our target universities, giving us the opportunity to meet potential applicants face-to-face. The pandemic has meant those face-to-face opportunities currently aren't possible and has therefore led us to think differently. Instead, we are aiming to strengthen long term relationships with universities as well as planning to hold our own virtual events. These events will give graduates an understanding of what it's like to work at Meggitt, what to expect throughout the application process and provide them with an opportunity to ask questions before they apply. We're also focusing more on social media and ensuring our website is really user-friendly and contains everything a graduate might want to know.

What were the positive things about the change?
We already knew there was a huge opportunity for us to engage with students in a different way and the pandemic has encouraged us to explore these opportunities and make them happen! It's pushed us all to think differently in every element of our work, which helps us to make lasting improvements. For example, we're now using more technology to reach students, which will allow them to hear from a range of our current graduates and senior leaders, rather than just meeting one or two people at a careers fair. They'll also be able to engage with us earlier and more regularly too.

Another positive impact of the pandemic is the experiences many of our current graduates gained from working on projects such as the VentilatorChallengeUK, which brought huge value to our wider community and the pandemic response.

What was challenging/less effective about the change?

The pandemic has naturally led to some organisations changing their approach to recruiting graduates and interns, whether that is cancelling offers and future opportunities or pausing recruitment during this period of uncertainty. This has unfortunately led to fewer opportunities for graduates in some areas. However, there are still lots of great organisations recruiting graduates despite the current climate, so I would encourage graduates to broaden their search and consider different opportunities.

Another challenge organisations will face is how to demonstrate their culture virtually. Generally culture is experienced and seen in person; however, it is possible virtually – it will just take a little more planning and lots of communication!

What advice would you give to colleagues interested in implementing or building on your innovation?

It's a really challenging time for students at the moment, particularly those who may have had internships cancelled. My advice to students would be to explore any opportunities they can to gain exposure to employers – they could get involved in their university's engineering societies which often provide opportunities to work on projects with employers. They may also be able to complete internships or work experience outside of the usual internship timelines, which would give them the exposure to employers and prepare them for their career in professional engineering.

I believe that educators should be talking about career opportunities earlier, by inviting a range of employers to engage with students via seminars, lectures, and projects (in person or virtually). This will give students exposure to a wider range of career opportunities out there, which in turn allows them to broaden their horizons and job searches. It also gives them the experience of engaging with employers early on in their studies, so they'll be more prepared when it comes to applying for graduate jobs.

Student Perspectives

Throughout this section, student surnames refer to the student perspectives presented alphabetically by surname in Part 2 of this volume.

As noted from the student poll reported in the webinar (see Figure 4.1), students find extra-curricular activity and internships particularly important for enhancing their employability. Thomas shares some of the challenges presented by working on extra-curricular activity including practical manufacture and build work,

whilst simultaneously highlighting how much of the project was able to continue in online form. He makes several practical recommendations for how universities might support students – in ways that would allow them to be self-sufficient – to keep their extra-curricular work going as COVID-19 restrictions persist.

Resalat, Mitchell and Stainer, discuss experiences of internships. Resalat recognises particular value from a year in industry with Dyson for developing professional capability. She highlights especially that the experience helped connect theoretical knowledge from her studies to real user needs and behaviours. This practical application of learning was particularly important in determining her future direction. In looking ahead, she challenges educators to think about how professional learning could be more effectively embedded within degree programmes to allow students to discover their agency as problem solvers working with real stakeholders and deliverables.

Mitchell's placement experience was entirely online, as a result of the pandemic – a new experience for him and the placement provider, with both working together to establish their approach in an initial trial week before the placement was extended. He notes that working from home removed constraints from travelling to and from work, and allowed him to focus on the project he was given, although this meant having to adapt approaches to communication, and some novel approaches to team building. He observes that department leaders were crucial sources of information, and proposes a similar model for use in education, which could have value in fostering teaching teams rather than individual module leaders.

Stainer's experience was of a placement overseas, undertaking an industrial research project, leading to a co-authored publication. Although an impact of COVID-19 was to prematurely end the research phase of this experience, Stainer notes many positives from working at home, including more flexibility in learning to manage her own time, with positive effects on well-being. More negative aspects were the loss of opportunities to network internationally, and to engage in a wider range of extra-curricular activities whilst in another country, all of which have scope to build and enhance employability and transferable skills.

Huang discusses how the cancellation of summer plans became a stimulus for reflection on how to most effectively utilise the period productively, leading to new learning opportunities. He recognises the value of communication skills for engineers, and demonstrates capability in thinking broadly for ways to develop these through opportunities accessible within the university community. Success is evident in Huang's securing a virtual internship as a result of his writing a science and technology column for a student newspaper. He notes that supporting students to develop writing skills is often not the

focus of curriculum-based teaching, despite the fact that most students lack experience to do this well, and calls for more support to be embedded.

The theme of self-motivation continues in Boland's reflections on how learning online has fostered learning for understanding and application, as opposed to recall. Noting the need for a more self-directed approach in learning online, Boland observes that his strategy for learning became more like that of exam revision: breaking material down into smaller parts and using practice questions alongside it. This experience reminds us of the need to consider how we segment learning for current times, where there is greater scope to break from the traditional timetable of hour-long classes. Boland also notes that open-book assessments prompted a switch to challenges of applying learning to solve problems, rather than simply questions of recall – highlighting an opportunity to build employability through different styles of assessment.

Findlay, recounts his experience of studying abroad last year, and having to rapidly return to the UK as lockdown took hold. An important employability consideration he highlights is in the context of group projects, where he was not only having to work with peers online, but also at a distance across time zones, meaning his working day had to shift to encompass his evening, UK time. Nevertheless, succeeding in managing this work provides an excellent opportunity to experience the realities of the modern working world, where teams are often not co-located. Similar issues are explored by Boufidis, who identifies more flexible approaches to teamworking as one of the biggest learnings he takes away from his experiences of studying during the pandemic. His team's approach has parallels to much professional work completed at a distance, as he notes that team members learnt to trust each other more, to enable asynchronous collaboration using online tools.

It is clear from the student perspectives outlined above, and the full detail in their own writing included in Part 2 of this volume, that students found both challenge and opportunity resulting from the COVID-19 pandemic. Many of the challenges they report highlight opportunities for engineering educators to enhance practice in terms of supporting employability, by integrating support for students to address learning gaps they perceive, whilst there is much to learn from what they identified as opportunities we can build on and retain.

References

Bass, J. M., McDermott, R. and Lalchandani, T. (2015) 'Virtual Teams and Employability in Global Software Engineering Education', *Proceedings of the 10th IEEE Conference on Global Software Engineering (ICGSE)*, pp. 115-124.

Baytiyeh, H. and Naja, M. (2012) 'Identifying the Challenging Factors in the Transition from Colleges of Engineering to Employment', *European Journal of Engineering Education*, 37(1), 3-14.

Calcagno, L., Walker, D. & Grey. D. (2017) Building Relationships: A Personal Tutoring Framework to Enhance *Student Transition and Attainment. Student Engagement in Higher Education Journal*, 1(2), 88-99.

Engineering Council (2014) *The Accreditation of Higher Education Programmes*. 3rd Edition. Engineering Council.

Gibbs, B. and Wood, G. C. (2019) 'Reflection for Learning and Practice in Developing Engineers', *in* Andrews, J., Knowles, G., and Clark, R. (eds) *Excellence in Engineering Education for the 21st Century: The Role of Engineering Education Research: The Proceedings of the 7th Annual Conference of the UK & Ireland Engineering Education Research Network.* Coventry: WMG, University of Warwick, pp. 122-133.

Grey, D, and Osborne, C. (2020) Perceptions and principles of personal tutoring. *Journal of Further and Higher Education*, 44(3), 285-299.

IET (2014) *Skills and demand in industry: Annual Survey 2014*. Stevenage: Institution of Engineering and Technology. Available at: www.theiet.org/media/1361/skills-survey2014.pdf.

IET (2019) *Skills and demand in industry: Annual Survey 2019*. Stevenage: Institution of Engineering and Technology. Available at: www.theiet.org/media/1361/skills-survey2014.pdf.

Magolda, M. B. B. (1996) 'Epistemological Development in Graduate and Professional Education', *The Review of Higher Education*, 19(3), 283-304.

Tomasson Goodwin, J. et al. (2019) 'Can students be taught to articulate employability skills?', *Education + Training*, 61(4), 445-460.

UKAT (2020) UK Advising and Tutoring. Available at: www.ukat.uk (Accessed: 22 July 2020).

Wakeham, W. (2016) *Wakeham Review of STEM Degree Provision and Graduate Employability*. London: Department for Business, Innovation and Skills/Higher Education Funding Council. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/518582/ind-16-6-wakeham-review-stem-graduate-employability.pdf (Accessed: 17 July 2020).

Wood, G. C. (2020a) 'COVID-19: Educator Priorities and Some Tools To Help', *Dr Gary C Wood*, 16 March. Available at: www.garycwood.uk/2020/03/covid-19-educator-priorities-and-some.html (Accessed: 7 July 2020).

Wood, G. C. (2020b) 'Scheduling Success: A Student Guide to Managing Time whilst Learning Online', *Dr Gary C Wood*, 20 April. Available at: www.garycwood.uk/2020/04/scheduling-success.html (Accessed: 29 June 2020).

Wood, G. C., Findlay, A. and Resalat, T. (2020) 'What does moving online mean for employability?' *Educating Engineers: Lasting Impact From Crisis Innovation*. York: Advance HE Connect. [Webinar, 9 June 2020].Yorke, M. (2004) *Employability in higher education: what it is - what it is not*. York: The Higher Education Academy/ESECT. Available at: www.advance-he. ac.uk/knowledge-hub/employability-higher-education-what-it-what-it-not.

Chapter 5

How do we partner with students in learning design at a distance?

Beverley Gibbs[1] & Gary C Wood[2]
[1]New Model Institute for Technology & Engineering
[2]University of Sheffield

••

This chapter asks what student engagement might be taken to mean in our current context, and argues that COVID-19 has disrupted established practice and student-staff relationships in a way that represents an opportunity for deeper partnership work more likely to lead to transformative effects. Its call to action argues that involving students in designing the 'socially-distanced campus' is the right thing to do, can lead to better design decisions, and helps build engagement and commitment. It shows how numerous institutions around the world are recognising that students are experts in their own learning and can fulfill powerful roles as pedagogical consultants. Colleagues are invited to build on the pandemic's disruption to reshape their relationships with students and nurture the role of students in the learning community.

In normal circumstances, most universities would be confident in their claims that they have processes for listening to and responding to students, and governance structures that incorporate student representation. Indeed, in recent years, many of these activities have been strengthened by growing attention to the concept of 'student voice'. This is not without challenges, and it can be difficult to have conversations narrowly focussed on satisfaction that do not reify the conception of students as consumers.

In seeking to construct more meaningful relationships with students, more expansive conceptualisations of the educator-student relationship have increased in salience, including the idea of 'students as partners', a term that partly overcomes the difficulties in talking about 'student engagement'.
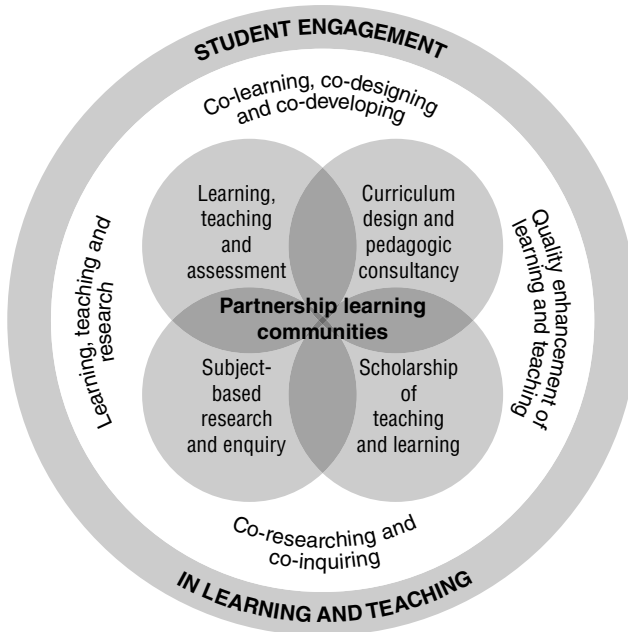
STUDENT ENGAGEMENT
Co-learning, co-designing and co-developing

Learning, teaching and assessment

Curriculum design and pedagogic consultancy

Partnership learning communities

Subject-based research and enquiry

Scholarship of teaching and learning

Learning, teaching and research

Quality enhancement of learning and teaching

Co-researching and co-inquiring

IN LEARNING AND TEACHING

Figure 5.1: Four areas of student engagement in learning and teaching[1]

'Student engagement' is a very broad term in the context of learning and teaching, encompassing both students' commitment to their own and peers' learning, and their involvement as collaborators in learning and teaching scholarship, curriculum design and pedagogic consultancy. Healey, Flint and Harrington (2014), summarise this fuller breadth of student engagement in Figure 5.1, and outline four domains of activity.

The first – learning, teaching and assessment – is a populous field of activity in HE. It includes students' engagement in learning, as well student voice activities such as evaluations, and staff-student committees. The second – curriculum design and pedagogic consultancy – recognises and involves students as experts in their own learning and may be manifest as students (co)designing course structures, aims or learning materials. The third – scholarship of learning and teaching – acknowledges students as participants in structured investigations into concepts of learning and teaching, drawing out their standpoint in interpreting findings. And finally – subject-based research

---

[1] Adapted from Healey, Flint and Harrington, 2014.

enquiry – recognises students as partners in the research endeavour, as it pertains to the particular discipline. This might involve research internships or meaningful contributions to research agendas through dissertations.

Viewed within this framework, student partnerships can be understood as a spectrum of activity where students have differing levels of control over the process, different relationships with staff, and are conceptualised as making a range of different contributions. Whilst some forms of partnerships (particularly those associated with 'student voice') have become more prevalent in recent years, they have not always had the transformative impact we seek. Examples of students co-designing learning experiences in any discipline are few and far between, despite the benefits offered: real understanding of how students learn, and how they make sense of their learning. For colleagues wanting to innovate for the benefit of attainment and satisfaction, this depth of understanding is both motivating and inspiring. For colleagues who are fundamentally changing the structure of learning and teaching – as COVID-19 responses require – there are ethical, substantive and instrumental reasons to consider this depth of understanding as a baseline: it is the right thing to do, it can lead to better design decisions, and it helps build engagement and commitment (drawing on Fiorino 1990). Colleagues may be considering how student partnerships inform universities' legal responsibilities to effectively manage changes to courses, as the sector navigates the limits of the *force majeure* clause in student contracts (Dickinson 2020).

Practically, how do we go about such partnerships? Some cases of substantive student partnerships are available to help bring the idea of students as pedagogical consultants to life:

- Bishop's University in Quebec, Canada, have recruited a team of 23 student mentors, selected on the basis of their commitment to 'relationship-rich' learning and possessing the skills necessary to build relationships with staff. In their consulting role, students will work collaboratively with staff in preparing for COVID-impacted teaching in the Autumn 2020 semester and beyond. The student mentors will '...develop critical empathy, so they are aware of, and can appreciate and make visible, the discomfort and disorientation for both instructor and learner in a learning environment radically disrupted by a global pandemic' (Riddell 2020).
- Western Sydney University launched a new module in Spring 2020 called *We Are The University: Students Co-creating Change*, which '...offers students a chance to learn, negotiate and practise change-making skills in, and for, our University', along the way getting '...a taste of what it's like to operate as a change-maker inside a large and

complex institution' (WSU 2020, WSU Students as Partners 2020).

- McMaster University in Ontario, Canada, offers an Applied Curriculum Design module for third- and fourth-year science students, who design learning activities for first year students (Goff 2014, cited in Healey, Flint & Harrington, 2014). Comparable work at the UK's University of Sheffield saw third year mechanical engineering students designing new experimental experiences for first-year students (Algar et al 2018), and Bovill offers accounts of similar activity at the University of Loughborough, where maths students designed worksheets for first-year students, and University College Dublin, where third-year geography students designed the Virtual Learning Environment for first years (Bovill 2013).

- In the UK, Oxford Brookes University's ePioneer programme provides a platform for students as reverse mentors to partner with staff in creating digital resources (Oxford Brookes n.d.). Digital technologies have been fertile ground for student partnerships, in particular students as 'change agents', with cases reported from a range of universities, including the University of Wolverhampton, University of Exeter, and the University of Greenwich (Ryan et al 2013). These rich case studies offer accounts of how students were recruited, how they achieved their impact, and what their experience of the process were.

- The authors' own work with engineering students who design not only learning experiences, but also the design process itself. Given an almost blank canvas, with only an aim and indication of scale, students proposed detailed, well-thought through learning that is innovative, personalised, integrates skills, knowledge and personal effectiveness, leverages the strengths of their home institution, and is feasible. This 'show-not-tell' approach to empowering students in learning design overcomes the many limitations of verbally-intensive methods such as focus groups and interviews (Wood & Gibbs 2019).

Across the sector – in pockets of inspiring practice – meaningful attempts at empowering students and mobilising them as change agents are emerging. On one hand, there are real reasons why this is difficult, including skepticism as to the value that students can bring, and more practical concerns to do with time and cost. On the other hand, the COVID-19 crisis has created a proliferation of cases where educators and students have learned together in managing the transition – adapting to new practices, and finding more effective ways to sustain interactions – with mutual patience and understanding.

Taking a moment to reflect on and share these experiences has the potential to revolutionise our understanding of students as partners. There is significant opportunity to build on this as we continue to develop our capacity to engage with students to shape learning experiences for the coming academic year, and to learn from the changes we are introducing. Universities that successfully capitalise on COVID-19's disruptive impacts can reshape relationships with students and their role in the learning community. Colleagues might reasonably expect more satisfied students, a student offer better aligned with the needs and desires of 'Generation Z', and an environment where students share with staff a commitment to continually improve and innovate learning and teaching.

Network Activity

The *Lasting Impact from Crisis Innovation* webinar, *How Do We Partner With Students in Learning Design From A Distance?* (Collins 2020) represented the final theme in the series, and reflected the PPPEE network leads' observations and concerns about student partnership in learning design responding to COVID-19 disruption. Our observation was that students and staff were working together more closely on learning design, but in unconscious partnership, and our concern was that, in consequence of these collaborations being unconscious, student perspectives were not very high on the agenda of staff, and the discussion as to how students could be more meaningfully involved was stilted.

The webinar was led by Trevor Collins of the Open University; the OU is the UK's largest undergraduate University, and most students are off-campus. The webinar began by highlighting the nature of openness in the OU's mission, and discussed important differences between synchronous and asynchronous activities, and differences between traditional and distance learning. Next came theories of *transactional distance* (Moore 1973, 2018) and *conversational frameworks* (Laurillard 2002) to encourage participants to think about the nature and format of desired student-educator interactions as a primary consideration that could go on to underpin subsequent technology decisions.

The main focus of the webinar was the use of Healey, Flint & Harrison's framework (Figure 5.1) to structure a review of how the OU engages and works in partnership with its students. 63 participants were asked which forms of student partnerships they had been most involved in:

- 40% said 'learning, teaching and assessment'
- 19% said 'curriculum design and pedagogic consultancy'

- 13% said 'subject-based research enquiry'
- 10% said 'scholarship of teaching and learning'
- The remaining 18% did not respond, or commented 'none'

Next, participants were presented with some examples of each kind of work. In the *Learning, Teaching and Assessment* segment, students in Introduction to Computing and IT have co-designed assessment, with outcomes that include new quizzes and recommendations for both formative assessment and further student co-design practice (Open University n.d. a). In the *Curriculum Design and Pedagogic Consultancy* segment, we looked at the OU's curriculum design panel, involving more than 2,000 students in surveys, interviews, beta testing, critical reading, developmental testing and workshops that span the module level to general activities. (Open University n.d. b) In the *Scholarship of Learning and Teaching* segment, student-led scholarship in sciences has explored relationships between assessment extensions, study intensity and student success (Open University n.d. c). And finally, in the *Subject-based Research Enquiry* segment, the OU OpenScience Observatories, part of the OU OpenSTEMLabs initiative were highlighted (Open University n.d. d). In the Open Observatories, students plan investigations, control telescopes and collect data to build long-term datasets and some student publications. This part of the webinar ended with a summary of tools and techniques for different kinds of synchronous and asynchronous activity.

Next, webinar participants were invited to share their thoughts on a Padlet populated with 4 questions. Participants' responses included:

1. **Why do you want to partner with students in the next 6-12 months?**
   - Our students have had the opportunity to be online learners. We need feedback from them to enhance future learning experiences; working with students as partners [will] improve the experience going forward.
   - We need to shape learning experiences for next year that draw on their experiences of learning online this year – they are now relative experts in learning in that format.
   - Under current circumstances we are transitioning to online teaching so this is very new for students who have face-to-face expectations.
   - We are all learning this at the same time – students can help us with this.

2. **How have you been partnering with students in the last 4 months?**
   - Not yet – just keeping head above water so far.
   - Transition has been very busy so no true partnership – very busy with online exams and marking moderation.
   - Accidentally – learning what doesn't work and what does work through being in an environment where we're all learning together.
   - Focus groups as part of [VLE development].
   - Daily communication with students to understand their learning experiences.
   - Discussing current/topical matters in class.
   - Getting students involved in module design/redesign will help them appreciate the difficulties and help manage expectations.
   - By asking students to co-design learning experiences with me.

3. **What tools and techniques can you share for online conversations?**
   - Microsoft Teams, Zoom, Big Blue Button, email, Canvas Conference, Facebook Groups, Snapchat, Skype for Business, WattsApp, Google Meet, Virbela.com and iSeeVC (3D VR environments using 360 degree spatial audio), visual collaboration tools such as Mural, Klaxoon and Miro.
   - Sometimes being a lone user can cause its own problems – students seem to prefer some consistency in how things work, and having educators using very different platforms can be confusing.
   - 'It strikes me that this question demonstrates lots of diversity in tools, but the other questions represent lots of similar activities. So, it's not about the specific tools in a lot of instances, but what we do with them'.

4. **What is your one recommendation for student partnerships after COVID-19?**
   - Focus more on this area of authentic partnerships, as the outcome will be very rich.
   - Adapt to new technologies and tools for online conversations.
   - Increase amounts of formative assessments and feedback.
   - Use it as an opportunity to engage beyond 'the usual suspects' – different formats can lead to new voices.
   - Get the students to *show* you how they'd like to learn, rather than relying on their ability to tell you what they want. It leads to

> much richer learning for you as the educator, and the process of
> designing what they show you encourages much better reflection
> in the students.

The breadth of these responses demonstrates a genuine desire to partner with students, to learn together, improve the learning experience, and to help manage expectations. They also communicate a reality many have been living: one of high workload and an unremitting series of urgent tasks that has led to drastic prioritisation. Despite this, there was a confidence that working alongside students in the COVID-19 transition was a worthwhile and meaningful activity, and there is a plethora of tools to help us do that from a distance.

Cases of Practice

In this section we share four up-to-date cases of good practice relating to the broad theme of student engagement. **Alexander Lunt** (University of Bath) shares the power of Sli.do in revitalising interactivity and engagement in the large-scale synchronous teaching of solid mechanics. **Chris Headleand** (University of Lincoln) shares the pirate-island video game environment' by which prospective students can explore the university environment, interact with 'staff' and undertake quests. **Marzia Milan** and **Thomas Baker** (University of Huddersfield) discuss the use of Microsoft Sway to develop more interactive and engaging material for asynchronous delivery. **Suzanne Faulkner** (University of Strathclyde) shares her use of Snapchat as a more intuitive, social medium to maintain fluid communication with students. We hope these cases offer encouragement, reassurance and inspiration; do get in touch with the contacts if you would like to hear more.

One of the striking things about the practitioner case studies in this webinar series is the absence of cases that focus on students as active partners in learning design, even though this has been a time of significant reorganization and change. In contrast, many of the practitioner cases shared innovations that have proven to be fast, effective, and imaginative ways to remain connected with students. This concern – with maintaining dialogue with students – was reflected in the very first webinar poll (Chapter 1) asking what was on colleagues' minds. In some senses, this focus is not surprising: crisis management literature repeatedly stresses the need for fast, accurate and clear information, and it is wholly appropriate that effective dialogue was a priority. In parallel, and perhaps in contrast to normal times, there have been lots of examples of students and educators learning together about how

to operate in disrupted times. In the coming months, we hope colleagues continue to share their student engagement work as a foundation for designing the socially-distanced campus.

Case Study 5.1
Alexander Lunt
University of Bath

What was your innovation and its context?
This case study presents the use of the interactive web interface Sli.do to perform polling during first-year undergraduate engineering lectures on statics in solid mechanics. This syllabus is fundamental to many subsequent modules and is typically a brand-new topic for students. The subject is perceived to be quite dry, theoretical, and hard to follow, which has historically led to low student engagement. When revamping the course, I integrated Sli.do polling into all 12 lectures. Polls were prepared ahead of time to launch them 'live' at the appropriate point. The software simply requires the student to go to the website and input a code to participate. I ran 32 polls during the course, receiving a total of 6,669 votes, with an average of 248 ± 51 users per lecture, and a total of 2,073 likes from students. Sli.do questions are a powerful approach that the students can use to interact with the lecturer and each other. During the course, there were 438 comments sharing thoughts/ideas/problems, answering each other's questions, or highlighting issues during the lecture, e.g. 'slow down please'. This online approach can seamlessly be integrated into virtual lectures to promote student interaction and dynamic teaching methodologies.

What were the positive things about the change?
The Sli.do platform was particularly effective for identifying regions of reduced understanding in order to allow me to quickly and effectively recover areas of concern. The approach intrinsically embraces assessment for learning and was found to be effective at breaking up a lecture into shorter sections. Students were found to be significantly more engaged, and attendance was maintained at almost twice the rate of previous years. It was also found that Sli.do questions were an effective tool for peer-to-peer learning during the lecture. The students provided strong positive feedback on the use of Sli.do (50% of all feedback was pro-Sli.do comments). They enjoyed the instant feedback provided, and the ability to immediately apply the strategies being taught in the lectures. They also praised the ability to engage with the lecturer and each other, and the resulting dynamic interactions.

What was challenging/less effective about the change?

It was found that not all question types were appropriate for a Sli.do poll. The need to provide answers ahead of time ensures that opinion-based questions are difficult to frame, and students could not enter formulae or units to check this understanding. Preparation of the appropriate questions, polls and integrated lecture slides takes considerable time investment, and it was found that the polls need to be fully integrated into handouts for full effect. The live poll tracking feature of Sli.do was also ineffective, as some students would see the most popular solution and subsequently choose not to respond. However, the main issue was the anonymous nature of the questions, which was used by a small minority of students to post inappropriate comments. Whilst it is possible to turn off this functionality, this essentially removes student feedback and the dynamic teaching approach offered by the software.

What advice would you give to colleagues interested in implementing or building on your innovation?

- Do not show live poll results.
- Once 50% of the votes have been received, give a time warning.
- Use the period when the students are answering polls to check questions.
- Integrate Sli.do into lecture slides and handouts for maximum effect.
- Inform the students that the questions will be monitored, and call out inappropriate comments. Leave plenty of time to run each poll (>5min).
- Afterwards, go through the question in detail and recover areas of concern.
- Use a laptop to show the slides and a PC to run the poll, to facilitate rapid switching between screens and eliminate Wi-Fi issues.

Case Study 5.2
Chris Headleand
University of Lincoln

What was your innovation and its context?

We noticed on social media that students were missing the campus. Although the value of university is not in its buildings, the location and environment play a significant part in a student's experience. Every university has a place on campus where students take photos at graduation, and alumni will often reflect over their memories of specific features, such as halls and labs. Furthermore, new

applicants were unable to come on site as they normally would. Video games have been shown to relieve stress, so to try and combat some of the isolation that individuals were feeling we built a recreation of the university campus as an interactive video game environment. The 'University on Lincoln Island' is a scale recreation of the University of Lincoln, built in the style of a pirate island. The island is populated with many non-player characters (NPCs) who have personalities, and narratives based on real staff and students who have lent their likeness to the game. In the Lincoln island game, students can learn to navigate the university, while interacting with the NPCs and participating in quests and mini-games. The game was published on the Microsoft store, and has been downloaded several times and given 5-star reviews from users.

What were the positive things about the change?
The game has been well received by staff and students alike. Students have shared experiences of playing the game online and have used the game to share experiences. Furthermore, we have used the game during open events to provide virtual tours of the campus. In its primary goals of providing a virtual space for current students and supporting the transition of applicants it seems quite successful – though we will be conducting a full evaluation later in the year. We have also had an added benefit that has come from the production process. We gave staff and students the opportunity to fill out a form with some basic questions to capture their thoughts about campus (such as favourite locations). We imbued our NPCs with these responses and as an interesting artefact that has captured an aspect of the 'Lincoln experience'.

What was challenging/less effective about the change?
The most challenging aspect of this change has been its delivery. In less than a month we developed a full video game and took it through the publishing cycle. Anyone experienced with software development will understand how challenging that is. We were fortunate that we had a strong team with several years of games development experience – and this is something that people would need to consider if trying to implement something similar. Another challenge comes from the gameplay itself. We were exploring new ground as this is the first game of its type. Designing gameplay that is fun, while achieving the stated goals was a novel challenge. Furthermore, designing gameplay that was consistent with the university's ethos needed to be considered. Something we have identified for future development is that the game would benefit from a multiplayer mode. If we were able to do multi-play we could deliver a range of pastoral support induction, and tours through the game.

What advice would you give to colleagues interested in implementing or building on your innovation?
Building something like this requires a significant investment in time and workload and requires a team of people who understand games development. Beyond implementation, taking a game through the publishing process (to make it broadly accessible) requires a level of expertise. Virtual environments like these could provide a range of opportunities for institutions, but they are specialist developments and they need support from your senior leadership. My second piece of advice would be to prioritise fun. Many games placed in an educational environment fail because engagement is not considered a priority. If you can create a FUN experience, it will hold the players' engagement – allowing you to deliver the learning or pastoral content.

Case Study 5.3
Marzia Milan & Thomas Baker
University of Hertfordshire

What was your innovation and its context?
This case study discusses the use of Microsoft Sway to develop teaching material for asynchronous delivery during the COVID-19 pandemic, to improve students' engagement within engineering subjects. Sway is a Microsoft Office App that can be used to create and share interactive lecture content (accessible on-demand) from any device with an Internet connection and a screen. The built-in design engine allows integration of a variety of sources and types of information – such as notes, slides, multimedia files, and hyperlinks – in one appealing dynamic page that the student can access remotely. In the *Product Development and Project Management* engineering module, Sway was used to create a more student-centric and active learning environment for students. Conventional pre-recorded PowerPoint lectures (narrated by the tutor) unfortunately perpetuate a paradigm of didactic teaching entirely based on passive learning. With Sway, the student is completely in control of accessing the lecture content and searching for the information needed for the tutorials or practical sessions. The tool allows learners not only to follow the most suitable route and find appropriate learning material to suit their cognitive characteristics, but also to explore different sources of information.

What were the positive things about the change?
The introduction of Sway interactive presentations appears to have had an overall positive impact on enhancing the learning experience and improving

the learning environment's effectiveness. While the statistics for student views of the material across the module remained stable across the weeks of the COVID-19 lockdown, the sections presented using Sway had noticeably higher achievement in the corresponding online open book exam questions at the end of the semester. Not only were the overall marks better on the 'Sway' sections, but students demonstrated significantly better understanding and application of the material in these questions. Moreover, students commented in their module feedback that they enjoyed the Sway material which one student described as being 'never boring'.

What was challenging/less effective about the change?
The interactive presentation can unfortunately not substitute the face-to-face interaction and the potential exchange of ideas that occurs in a traditional lecture. While Sway allows a more student-centric learning environment, as with other forms of online delivery it does however require individual learning commitment as the student is engaged alone with the activity. This also highlights the need to develop strategies and alternative activities for enabling discussion among peers beyond just the typical group assignments given. Another challenge brought by limited class-contact is how to make effective use of a delayed feedback system. In a physical class, the student can receive immediate clarifications and input as those are needed. Therefore, an important step is to identify strategies which enable immediate feedback (such as self-assessment tools, forums, chats). These challenges are shared with other forms of non-synchronous online learning and a tutor using Sway should also keep these in mind.

What advice would you give to colleagues interested in implementing or building on your innovation?
First, it is advisable to begin with small presentations and to couple the presentation with tools for self-assessment for guiding the students' learning. Second, it is useful to limit the scope of a Sway presentation: ideally all the content and additional material for a topic should be manageable and easy to access for students in one session. Lastly, the self-assessment should be appropriately challenging for a range of students: to further encourage students to engage with the activity and discussion to solve given problems, and to boost student's confidence in the subject matter.

Case Study 5,4
Suzanne Faulkner
University of Strathclyde

What was your innovation and its context?
Following a failed attempt to engage with students using the forum function of the institutional VLE, a conversation with students confirmed that this lack of engagement was not due to lack of interest; instead it was due to the number of clicks required to engage in this process. As a tutor who has an active interest in innovative ways of learning and teaching, a discussion ensued with regards to where the students would be happy to communicate with their tutor – the answer was Snapchat. The Snapchat tutorial group had been established prior to lockdown due to COVID-19 but the group chat evolved from providing educational support, to include pastoral care. In this time of uncertainty, the Snapchat group became a place to share concerns, frustrations, and to ask questions. As lockdown progressed, the Snapchat group helped to further develop connections with the course content, each other, and the course tutor. Additionally, the students were able to support each other. Despite the challenges of attempting to revise in such uncertain times, increased engagement was observed within the group (see Figure 5.2). Communication was not limited to course content with students, but included the tutor sharing concerns and positive ways to manage mental health in lockdown.

What were the positive things about the change?
Using Snapchat as a communication and tutorial tool during lockdown due to COVID-19 has made a significant positive impact on the students, many of whom described the Snapchat tutorial group as a lifesaver during this time. When asked: What did the use of Snapchat during lockdown mean to you? The common themes in responses were:
- An appreciation of the immediacy and ease of communication.
- Communicating in short bursts helped students to stay focussed on their revision during difficult times.
- Support from the lecturer and classmates.
- Reduction of fears, they felt able to share.
- The provision of academic and emotional support. This was illustrated by one of the students with this response: 'Not only have we been given extra support with regards to our education but also emotional support at a time when we've needed it the most. We have been able to voice our concerns knowing we're being listened to'.
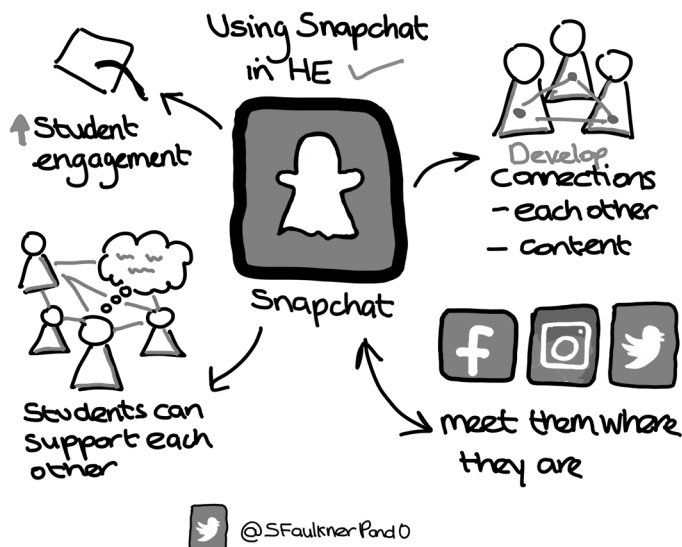
Figure 5.2: Using Snapchat as a tutorial tool in Higher Education

What was challenging/less effective about the change?
A challenging aspect of using Snapchat as a tutorial tool is the prospect that students may feel that, due to the nature of the platform, the tutor is available 24/7. Additionally, there is the concern that inappropriate content may be shared on the group. Therefore, managing expectations and establishing ground rules with the students for the group at its inception is required. It must also not be assumed that the students are proficient in using Snapchat for tutorial purposes. For example, if sharing an image taken in the app (perhaps of a PowerPoint slide) it can be viewed only once, if that image is shared from the camera roll it can be viewed indefinitely. Of course, not all students choose to be on Snapchat, a screenshot of important relevant content was shared on the class Facebook page which everyone had access to. An additional challenge is the maximum group size of 32.

What advice would you give to colleagues interested in implementing or building on your innovation?
In using social media in learning and teaching it is important to establish 'where your students are' and subsequently meet them there. The decision to use Snapchat as a tutorial tool was guided by a discussion with the students. It is important to establish a sense of ownership of the group with your students,

involving students from the outset is recommended. Additionally, when using social media in learning and teaching, managing expectations is imperative: failing to do so could result in unrealistic expectations. Inform the students when you are likely to be available, essentially stating your social media office hours.

Student Perspectives

Throughout this section, student surnames refer to the student perspectives presented alphabetically by surname in Part 2 of this volume.

Our commitment to including students in all the work we do extends to the 'Emerging Stronger' project itself. To allow students to express their experiences of the COVID-19 disruption and resulting changes to their learning experience, we opened a writing competition where students could share their thinking around a range of themes. These are presented in Part 2 of this volume.

Almost no students chose to talk about partnerships, and the one that did reflected on being part of this network and webinar series. His is a lone, but powerful, voice: "COVID-19 has derailed the usually rigid structure of university teaching, uniquely bringing students and staff together at a time of separation. In the post-COVID world we have the opportunity to challenge preconceptions about what traditional university education looks like. The mutual understanding brought about by these exceptional circumstances have been enlightening for both parts of the university community and it would be a shame to lose this … It was fascinating to speak with professors about their teaching, an insight few students ever see. This experience made me realise the untapped value of collaboration between students and the academic community." (Findlay)

Other student perspectives do provide some insights into how staff-student relationships are perceived, and how COVID-19's disruption is inhibiting or enabling richer relationships. Most students who commented on this topic did so positively. Abboushi felt that an online format allowed peers to interact more than they normally would, because 'they felt less embarrassed behind a screen'. Similarly, anonymous student 6 commented, 'I am a very shy person, so asking questions was made very easy because I didn't have to show my face'. Hwang felt that there was better accessibility of lecturers in the online format, through email and the raise hand function in the software used in online teaching, and Pandya felt there was 'greater flexibility in terms of time

to approach the lecturers for doubts and questions made it easier for me on a personal level'. Finally, Crosbie comments on the increased accessibility offered by online formats: 'Lecturers at the University have been very accommodating and willing to hold virtual meetings on request. Organising an in-person meeting often feels like a lot of effort for a small question. However, having the meeting virtually means that it can be held and solved quickly, proving time efficient'.

Relationships between students and staff are the fundamental underpinning of student partnerships. Even tangentially, our student perspectives shed light on how online relationships can make it easier for shy or reserved students to be forthcoming. For more confident students, easier meeting practice without a commuting overhead allows them to continue with their learning more quickly. There is much more to be explored here as we move forward with a partnership approach, to both improve the learning experience and to build stronger relationships.

References

Algar, C., Charnley, G., Gibbs, B., Lewis, K., Mylon, P., & Wood, G.C. (2018) Co-Designing the Programme-Level Approach: Students in the Community of Practice. Facilitated panel discussion at the 12th Annual Learning and Teaching Conference, University of Sheffield, 9 January 2018. Slides available at: www.garycwood.uk/p/presentations.html.

Bovill, C. (2013) Students and Staff Co-Creating Curricula: An example of good practice in Higher Education? *In*: Dunne, E. & Owen, D. (eds.) *The Student Engagement Handbook: Practice in Higher Education*. Bingley: Emerald.

Collins, T. (2020) 'How do we partner with students in learning design from a distance?' *Educating Engineers: Lasting Impact From Crisis Innovation.* York: Advance HE Connect. [Webinar, 16 June 2020].

Dickinson, J. (2020) Changing Course? Seeking consent isn't as simple as it looks. WonkHE. June 29, 2020. Available at: www.wonkhe.com/blogs/changing-course-seeking-consent-isnt-as-simple-as-it-looks. (Accessed 10 July 2020).

Fiorino D J, 1990, Citizen Participation and Environmental Risk – a Survey of Institutional Mechanisms. *Science Technology & Human Values.* 15(2) 226-243.

Healey, M., Flint, A. and Harrington, K. (2014) *Engagement through partnership: students as partners in learning and teaching in higher education.* York: The

Higher Education Academy.

Laurillard, D. (2002) *Rethinking University Teaching: A Conversational Framework for the Effective Use of Learning Technologies*. 2nd Edition, London: Routledge.

McMaster University (2020) SCIENCE 3M03 – Applied Curriculum Design in Science. Available at: https://academiccalendars.romcmaster.ca/preview_course_nopop.php?catoid=38&coid=204164. Accessed: 14 July 2020.

Moore, M.G. (1973) Towards a theory of independent learning and teaching. *Journal of Higher Education*, 44(12), 661-679.

Moore, M.G. (2018) The Theory of Transactional Distance from: Handbook of Distance Education, Routledge. 21 Dec 2018. www.routledgehandbooks.com/doi/10.4324/9781315296135-4.

Open University (n.d. a) 'Student co-design of confidence-building formative assessment for Level 1 Computing & IT students', Available at: www.open.ac.uk/about/teaching-and-learning/esteem/projects/themes/innovative-assessment/student-co-design-confidence-building-formative-assessment (Accessed: 16 July 2020).

Open University (n.d. b) 'Curriculum Design Student Panel', Available at: http://community.open.ac.uk/curriculum-design-student-panel (Accessed: 16 July 2020).

Open University (n.d. c) 'How are students using extensions and what is the impact on success?', Available at: www.open.ac.uk/about/teaching-and-learning/esteem/projects/themes/supporting-students/how-are-students-using-extensions-and-what-the-impact-success (Accessed: 16 July 2020).

Open University (n.d. d) 'The OpenSTEM Labs', Available at: http://stem.open.ac.uk/study/openstem-labs (Accessed: 16 July 2020).

Oxford Brookes (n.d.) www.brookes.ac.uk/instepp. Accessed 13 July 2020.

Riddell, J. (2020) Online Learning and Technology Consultants: Building capacities for student mentorship and collaboration in the time of COVID and beyond. Available at: www.jessicariddell.com/about. Accessed 14 July 2020.

Ryan, M., Franklin, E., Galsingh, T., Potter, D., Wren, J., Kerrigan, M., Coombs, A. & Walker, S. (2013) Students as Digital Change Agents. *In*: Dunne, E. & Owen, D. (eds.) *The Student Engagement Handbook: Practice in Higher Education*. Bingley: Emerald.

Wood, G.C. & Gibbs, B. (2019). Students as Partners in the Design and Practice of Engineering Education: Understanding and Enabling Development of Intellectual Abilities. *In*: Malik, M., Andrews, J., Clark, R., & Broadbent, R. (eds) *Realising Ambitions: 6th Annual Symposium of the UK&I Engineering*

Education Research Network. Portsmouth: University of Portsmouth.

WSU (2020) We Are The University: Students Co-creating Change. Unit Handbook. Available at: http://handbook.westernsydney.edu.au/hbook/unit.aspx?unit=102791.1&ulocode=PAR_CTY. (Accessed: 13 July 2020).

WSU Students as Partners (2020) 'We Are The University: Students Co-Creating Change' Online video clip. YouTube, 6 July 2020. Accessed: 13 July 2020.

Part 2

Student Perspectives on COVID-19 changes

● ●

In the course of the 'Emerging Stronger' project, we wanted to identify ways to capture what students were thinking, and how they were experiencing the changes resulting from COVID-19 disruption; we wanted them to be as present in this discussion and reflection as educators were. However, we also recognised that our students were undergoing significant disruption, anxiety, and additional cognitive demands. To this end, we directed part of the network funds to incentivise written student perspectives that could be prepared on students' own timescales. A competition was launched towards the end of term, and promoted more consistently after the assessment period finished.

The submissions are collated and shared in this report in Part 2. We chose to present these separately from the chapters in Part 1, since many of the students' pieces cut across the webinar themes. The summaries of students' perspectives in each chapter highlight particular student voices that speak to the chapter's theme. All students confirmed that they were registered on an engineering course. As part of the call, students were offered anonymity and some perspectives are presented in this format. Because this work did not seek to be representative, we elected not to publish student affiliations so unwarranted generalisations would not be drawn.

Student Perspective 1
Ramzi Abboushi

How did your learning experience change?
My learning experience did not change as radically as I expected. Being able to tune into a lecture online in the comfort of my own home, without the hassle of commuting to and from campus, was comforting. Also, not having to worry about what to wear, eat, spending money and getting to lectures on-time, made it easier to just focus purely on gaining knowledge. One would think asking questions would be hindered by online lectures; however it was actually easier to quickly insert and question into the lecture, without messing up the flow of content. The main issue was losing out on practical experience. I was completing my Master's, which involved a team research project, where we would have had to physically fabricate our designs. This was not possible so we missed out on the lessons learned in that practical experience.

What were the positive things about the change?
1) Can wear whatever clothing is desired during online lectures. 2) It is easier to fit an online lecture into your schedule, as you do not have to commute. 3) Lack of commuting to lecture hall is beneficial for saving money, time, comfort and punctuality. 4) More efficient. 5) Pupils asked more questions as they felt less embarrassed behind a screen. 6) Lecturers seemed more responsive online in fora or emails.

What did you not like about this change?
The main downsides of this change were: 1) a lack of sociability and possibility of meeting and interacting with friends or discovering new people, be it in class, campus or during commutes. 2) The lack of physical practical learning experience is not favourable. 3) Talking over one another and/or technical difficulties during online calls are inevitable. 4) It may take longer for emails to be responded to due to increased traffic to lecturers/staff.

What would you like your lecturers to consider if they were adopting this change in the longer term?
1) Lecturers should consider improving their notes to suit the online methods: some lecture notes or slides depend on explanation by the lecturer to effectively teach, hence the notes or slides alone should be adequate to learn from. Alternatively, the lecturers should maybe make a basic script to their lectures so important points can be effectively and efficiently put across. 2) Creating online recorded practicals where the lecturer records/streams themselves

doing the practicals which we would have done ourselves. This could be a great way to learn as the lecturer slowly goes through the steps we would have done. As practicals are sometimes disorganised when left to our own devices, this could even be an improvement upon them. 3) Online question/quiz chat rooms could be an effective and engaging learning tool to test students and allow students to collaborate to find answers to difficult problems. 4) Refer students to more useful online learning materials, for example online textbooks/ebooks, or good websites to learn and expand our knowledge.

Student Perspective 2
Bianca Agapito

How did your learning experience change?
In all honesty, I believe that revising exam content using online platforms did not affect me as severely as I thought it would. Revision lectures were still organised, one-on-one help was clear, and if anything, getting support was a lot quicker, as email responses were faster. However, what I did find challenging was adapting to our alternative assessments which typically consisted of coursework and a one-hour multiple-choice exam; what made these exams particularly interesting was the fact that students were not allowed to go back and check answers. So how does one revise for this style of exam? How does one know how to manage the time for each question? How does one couple revision for these exams with additional coursework? The pressure [Pa] was high, but like any engineering exam, I just did the maths, the mocks, and – now more than ever – used all online resources wisely.

What were the positive things about the change?
Giving more confidence to students to participate during online lectures and screen-sharing were the two main things that I appreciated about this whole experience. Both were particularly helpful during this exam season, where students would typically be reluctant to ask for help in front of our large cohort. Similarly, screen-sharing was a good and clear way to show or demonstrate anything online. Furthermore, in contrast to students who found it hard to motivate themselves to revise due to open book exams and having the 'no-detriment' policy, I ended up only revising harder and more effectively because of the large uncertainties we faced, including: Wi-Fi potentially shutting down, other students cheating, pressing the wrong buttons in the exam software, etc. Additionally, despite facing the threat of having no back button in our assessments, it definitely made me more aware and careful about

my answers, which I appreciate.

What did you not like about this change?
On the other hand, the exam timetable and exam environment, were things that I believe 'dampened' my performance slightly. For instance, our exams were taken in one of the hottest weeks in the UK therefore, having my windows closed wasn't an option. Because of this, I was able to hear my neighbours talking, summer music playing through speakers, and (arguably more distracting) the smell of barbecues which, when you're trying to concentrate in an exam, isn't ideal. Moreover, despite not having any room timetabling issues or clashes on campus, the online exam timetable produced was quite disappointing. You'd think that the shift to online exams would allow the exam timetable to spread over this long period of time, however, this was not the case as on one day I had two exams which you could imagine was quite stressful.

What would you like your lecturers to consider if they were adopting this change in the longer term?
In my opinion, the lecturers at the School of Engineering did well in adapting to this change. They provided revision lectures, practice questions, and some had mock exams. However, provided that assessments are online in the longer term, I suggest that lecturers or the Engineering department should provide screen-recorded step-by-step, with separate videos on: how to access exam links and the examination portal; how to go through the exam (using a mock) from login to submission; and clear directions around/how to take advantage of platforms such as Microsoft Teams or module Moodle pages to learn content and collaborate with others. Although most of these were provided on one large document, I think that it is more helpful, especially for engineering students, to have a visual representation of things they should know. In return, students and lecturers will feel more secure about these online exams.

Student Perspective 3
Anonymous 1

How did your learning experience change?
I am used to being taught in a big space such as the lecture hall, and all of a sudden I had to adapt my learning to a small bedroom. I could not meet my lecturers to ask specific questions about a certain topic, it had to be by email or through the forum. The timings at which lectures started online differed

to when I was at university, so sometimes I would forget I had a lecture or a tutorial. There were no compulsory tasks that had to be done apart from coursework or exams.

What were the positive things about the change?
There were positives to learning at home. The biggest advantage was that I didn't need to travel anymore, I didn't need to get dressed into outdoor clothing, and I could stay in my bed throughout my lectures. For someone who has bad vision, it was great to have the lecture on my screen. In addition I did not need to switch my camera or mic on, so I could be eating or cleaning my bedroom and no one would know. Also, I was allowed to sit my exams whenever I was free within a 48 hour window, so there were no 'late' excuses or rushing to attend an exam.

What did you not like about this change?
It got boring. My friends were not next to me to encourage me to stay focused and I couldn't ask quick questions about a certain topic. Being stuck at home all of a sudden is difficult: students can develop mental health issues as our lifestyle has changed completely. The quality of the online lectures was not always excellent; there were connection issues, sound issues and display issues. Also, the assessments did not feel formal and it was not something I was used to. In addition, I missed out on essential lab work that could potentially have helped me in understanding my modules.

What would you like your lecturers to consider if they were adopting this change in the longer term?
The timing of the lectures needs to suit everyone. I understand it is impossible to make everyone attend lectures, but a bit more encouragement is needed to support everyone. Also, it would be really inclusive if lecturers were able to make their lectures more interactive to ensure that students are learning. Furthermore, finding an easy way to show our mathematical working out would be helpful. Now that the social distancing regulations have eased, it would be great if lecturers could meet up with students to discuss any issues.

Student Perspective 4
Anonymous 2

How did your learning experience change?
Having online lectures impacted my learning in a negative way, primarily due

to not being in a learning environment such as a lecture hall or a classroom. Exams becoming open book meant that the knowledge needed for the assessments could be the absolute minimum – suggesting that we would only need a basic understanding on how to solve the question, rather than acquiring a deeper understanding, which would have been beneficial in storing the information in your long-term memory. Having said this, I have had the opportunity to adapt to a new style of teaching which may be valuable for the future.

What were the positive things about the change?
One of the positive aspects of having to do assessments online was that I was able to work in the comfort of my own home. This took away the pressure that an exam hall would bring. Additionally, the pressure of exams was reduced when we were told that assessments were open book and we were given 48 hours to submit. This allowed for flexibility, which I was grateful for, as working around a noisy household posed a challenge.

What did you not like about this change?
I did not like the fact that there could have been potential technical difficulties regarding submitting the assessment. In addition to this, working in a loud household, as opposed to a quiet exam hall, was stressful. In terms of the actual online learning, I found it harder to communicate with the lecturers, and having no face to face interactions with peers for support was difficult. There were often clashes on tutorials which made me prioritise which module I thought I needed more support with. In reference to tutorials, it proved more difficult to learn from the tutors in maths modules, as understandably their working out was all typed, which was trickier to follow.

What would you like your lecturers to consider if they were adopting this change in the longer term?
If this way of teaching is adopted for the future, I feel it is important to make sure that it is easier to ask questions. In the software that we used, we had to request to ask questions which sometimes went unnoticed by the host.

Student Perspective 5
Anonymous 3

How did your learning experience change?
Lectures were made available online, and lecturers were rapidly responding to

emails, so that side of things was very similar to pre-isolation teaching for core modules. Examinations for these were a bit different – we were given multiple choice threshold tests, which granted a pass in the module and a base mark of 50%, and then a graded assessment which would serve to improve the mark – both were open book, as closed book conditions were impossible to enforce, and had a time limit of two hours. For the group project module, supervisor meetings moved online and lab work was halted. We were instructed to collaboratively write the report remotely – which is probably what we would have done anyway. The main change was the loss of lab experience.

What were the positive things about the change?
In my opinion, the two-stage open book examinations were the fairest way to assess us. It was somewhat difficult to pass the threshold tests and not have an understanding of the module. Truthfully, not much time was required to gain this understanding and pass, however. But I see that as a good thing, because to do anything else would run the risk of people failing modules in these conditions. Failing modules would have resulted in problems securing one's 'safety net' grade or even graduating at all. These assessments took pressure off us in what was a psychologically demanding time – having to obtain a degree whilst (probably) suffering in isolation. And graded assessments gave students the opportunity to distinguish themselves.

What did you not like about this change?
The graded tests were inconsistent. Luckily, I did not need to distinguish myself with a high grade – my situation was such that the outcome of those tests had minimal impact on my degree classification. I think the tests should have been more similar to past papers.

What would you like your lecturers to consider if they were adopting this change in the longer term?
Examinations should discriminate between different abilities of students, but in order to do that well, they need to balance consistency with challenge.

Student Perspective 6
Anonymous 4

How did your learning experience change?
All second-semester exams were online, as well as my thesis submission and all meetings with my supervisor. I had two modules with exams. One was

assessed by 25% coursework and 75% exam, and the other was 100% exam. In both cases, the online exam consisted of a threshold test and a graded test. The threshold tests were a set of multiple choice questions, on which we had to score at least 66%. They had to be completed within an hour of starting them, but could be started at any time in a two-week period. The graded assessments were much broader questions, which had to be completed within two hours of starting, and started within a 24-hour set window. For my thesis, I had to complete an online report submission, and a pre-recorded presentation. All supervisor meetings happened over Google Meet.

What were the positive things about the change?
The online tests were all open book, which made especially the graded assessments far better, in my opinion, at testing my actual understanding of the subject, rather than my ability to memorise material. Additionally, the fact that they could be started at our own convenience (within reason) greatly calmed my nerves.

What did you not like about this change?
It was hard to understand what some of the multiple choice questions actually wanted to know.

What would you like your lecturers to consider if they were adopting this change in the longer term?
Make all exams open book!

Student Perspective 7
Anonymous 5

How did your learning experience change?
It was a whole other world of education. The environment and surroundings I was used to were shattered and rebuilt in the blink of an eye. We switched to totalitarian online learning, where we would see the slides in lectures and no human faces. We had to partake in practical labs and watch equipment through a computer screen. The assessments were just a massive alteration. For some modules, we would type out answers into a PDF file. It's an understatement to say that doing integration by typing is as confusing as it gets. With others, it is an online multiple choice submission, as opposed to a normal 3-hr writing test. It honestly deprived students of the motivation and enthusiasm towards their course.

What were the positive things about the change?

As much as I prefer how things used to be, there came very few positives. The biggest one is time. I believe students felt like they now had more time to do everything that is expected of them. The fact that we no longer had to commute to, from, and between university buildings took off a whole chunk of time.

What did you not like about this change?

I could write a book about this! The most substantial negative impact that online learning has had on university students is lack of motivation. Every single person I have spoken to about the topic has agreed about that. Our inability to be in university buildings, libraries, and labs contributed to us forgetting why we chose to pay thousands of pounds to go to university. We forgot why we enjoy our course. Having to do my last exam on the kitchen table with my neighbour's baby screaming was peculiar, to say the least. The absolute lack of social aspects is especially tough. We missed the student community. Additionally, especially in doing an engineering course, it felt like a massive hindrance missing out on labs and practical education. It was like a big piece of my education was missing.

What would you like your lecturers to consider if they were adopting this change in the longer term?

I would like to say how much I appreciate all the hard work my lecturers have put in facilitating the transfer of the education process. They were also bombarded with huge challenges, so thank you to them! I would like it if they found a way to re-spark the interest in students. Ways to monitor and increase engagement with course content would be a great help as well.

Student Perspective 8
Anonymous 6

How did your learning experience change?

It was very difficult to sit behind a screen and focus on the lecturer's voice for more than thirty minutes. Quite often, I found myself feeling distracted and unable to concentrate due to the disturbance around me. Sitting in a lecture theatre is a very different experience compared to sitting at home watching an online lecture. I feel motivated and enthusiastic when I am surrounded by people taking notes and attentively listening to the lecture.

What were the positive things about the change?

I was able to attend lectures in the comfort of my own home! I am a very shy person, so asking questions was made very easy because I didn't have to show my face. The tutorials were extremely helpful, especially in my solid mechanics module.

What did you not like about this change?

The quality of the sound was very poor in some of the online lectures, so it was very difficult to understand the lecturer. Sometimes the Wi-Fi connection was very bad as well.

What would you like your lecturers to consider if they were adopting this change in the longer term?

To be better equipped.

Student Perspective 9
Anonymous 7

How did your learning experience change?

Everything has moved online and it feels like the full time university course has turned into a distance learning course – or even worse, a self-learning online course. Although support is still available from tutors online, I do feel that I would be able to gain much more support if I could find the tutors in person at university.

Many international students, including myself, have the thought that we have chosen to study full time and paid the full tuition fee and rent for having a full studying abroad experience. The situation is worse for MSc students who are only here and available for this year. My motivation for studying and continuing with the course has significantly been diminished over months of staying home. The only things that are still motivating me to work on my course are the deadlines of my assignments.

What were the positive things about the change?

Without the need of attending lectures at university, as everything has moved online and the lectures could be watched later on demand, I have been able to live a healthy lifestyle and exercise every day with a much less occupied schedule. In contrast to how most people have gained weight and been lazy at home during the pandemic, I have lost 30 pounds since the pandemic started.

What did you not like about this change?

It has been worse when the safety net policy promised by the university was amended for MSc students, which in my opinion, made the safety net insubstantial and generally negligible.

What would you like your lecturers to consider if they were adopting this change in the longer term?

For modules that require group projects and labs, the experience with these assessments will be significantly affected. Discussing technical stuff online is quite difficult in my opinion. Doing lab assignments without actually doing the lab is confusing and provides limited value and learning experience.

Student Perspective 10
Anonymous 8

How did your learning experience change?

I had to adapt to the working from home style, change my schedule and create a more flexible one to be able to keep up with house chores and revisions.

What were the positive things about the change?

It made me very organised, as I learnt how to manage my free time productively and found the best active studying hours where I could cut the time spent working in two. I also managed to learn how to be kinder to myself in terms of work and not put too much pressure.

What did you not like about this change?

The negative aspect, for me, would be the fact that I had to go through the changes without my friends, as I had to move back to my home country, so that was a bit of a challenge. It was hard to find motivation during this time, as a lot of things were happening at the same time and it was mentally exhausting to always give 100 percent of your full capacities in every domain.

What would you like your lecturers to consider if they were adopting this change in the longer term?

To always keep positive, and try to see the change as an obstacle for future growth. Life is always changing, so if we can picture it on a bigger scale, things that may hurt and bring discomfort now, won't matter in a few years.

Student Perspective 11
Anonymous 9

How did your learning experience change?
Weak. There was no motivation for myself to get out of bed and onto my computer to join lectures or seminars early, as they were all recorded, therefore reducing interactive time. Although the teaching materials were all provided, some were good and some not so. Being in the wrong environment had an effect on the work that was to be done.

What were the positive things about the change?
It allowed for more flexible learning. As lectures are recorded, it allows students to be more flexible in regards to learning. As a result, more time could be spent with family, for those who have parents with jobs that are not nine-to-five.

What did you not like about this change?
Minimal help and support was provided. For example, friends could not perform simulations as their devices could not be used, and the only advice given was to buy a new PC or wait until university opens. Granted, there are deferrals in place, but most students would just want to get assignments over and done with. Also, minimal support. My university typically has an open door policy, where support can be reached easily. However, during the lockdown, students' only way of contact was via email, which can sometimes be difficult to communicate with.

What would you like your lecturers to consider if they were adopting this change in the longer term?
Takeout examinations. A person should not be restricted in their own homes, although with 24-hour exams, this can be seen as a blessing and a curse. This can severely affect a students' health. When talking to some students after an exam, an exam designed with a recommended time of 3 hours took most students an average time of 16 hours, and some even more, which can have consequences to a students' health. Although assignments are not perfect, they can provide a real world environment. For instance, a person can always ask for help and search for information on the Internet.

Student Perspective 12
Muhammad Sabih Anzak

How did your learning experience change?
From the early stages of COVID-19, my school assured me that measures were being taken to move learning online, and we were provided a date that this change was to be fully implemented. From this date, we were no longer required to attend university; instead, lectures and tutorial classes were made available via a Blackboard Collaborate session online, which was accessed through the school's online learning environment. The decision to cancel all face-to-face exams was made fairly early on. However, it was unclear as to what the replacement assessments would entail until later on. It was eventually made clear to the us that these alternative assessments would be downloadable and would need to complete them (either hand written and scanned, or typed) within a 48 hour window and upload online to the school's website.

What were the positive things about the change?
Aside from the convenience of completing an exam without having to account for travel delays, I personally found the 48 hour window of completing an exam convenient. This is principally because at my parents' home (where I completed my assessments), I share caring responsibilities for my elderly grandmother, who has dementia. This means that for me, it can be difficult to get three straight hours of quiet time, which was the maximum amount of time that any one assessment should take, as stated by the school. However, with the 48 hour window, I was able to care for my grandmother, whilst also being able to find three hours within this period to complete and upload my assessment. Furthermore, the process of uploading an assessment was the same as uploading coursework, as we had done throughout the year, so there were no complications there.

What did you not like about this change?
I found the lack of knowledge about the assessment format and style stressful, and I know many other peers who shared this angst. For some time, between announcing that face-to-face exams had been cancelled to providing us details, it felt like limbo. This was not a huge concern for, say, a maths module, as revision could be carried out as normal. However, I am a Biomedical Engineering student, and for a module that required longer written answers, it was unnerving not knowing the format of the questions and how to tackle revision for an open book style exam. I think that more practice questions showing the format of the assessment were required here.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I would want lecturers to know that it is easy for students to feel isolated from study support when working in this manner. It is easy to feel like there is a lack of assistance available without office hours or face-to-face questions. I know that for me, and many other students, working from home can be quite taxing, and there are plenty of distractions going on that can neither be helped nor prevented. Lecturers accounting for this, and understanding that not everyone shares the same situation at home, is important.

Student Perspective 13
Matthew Boland

How did your learning experience change?
As a result of COVID-19, my learning experience became even more self-motivated, with no physical lectures or tutorial sessions to attend. This shifted my working pattern into something similar to how I revise, even though I was learning new topics. Instead of ingesting lectures as a whole, I would go through them once initially, before locking down each section by doing questions in tandem with each part; this also really helped me with my actual revision. I also changed my style of learning to suit open book exams: I anticipated more difficult and different exams to really test my understanding. As such, I spent more time learning the real content of the module, rather than studying past papers to assess question structure and patterns, which I usually do to help me in the exams. The new exam structures also influenced my revision to some extent.

What were the positive things about the change?
24-hour exams allowed me to show the true extent of my capabilities. I tend to get very flustered during exams, and make mistakes on questions that are well within my abilities, purely because of exam panic. The recent exams, made harder to account for open book nature, really let me show my deep understanding; I finished my 24-hour exam more proud of a paper than any I had ever previously done. I also appreciated the 24-hour period of all my exams, which allowed for comfort and preparation, meaning I began every exam in a good, calm state of mind.

What did you not like about this change?
One style of online exam involved scanned-PDF submission. I believe these

were to simulate real exams as closely as possible and allow for method marks. However, I don't feel I was given a comfortable amount of time to allow for the scanning and submission. Even before the exams I predicted my own cut-off point to allow for scanning, downloading onto the family PC, emailing over to my laptop, compiling into a single PDF, downloading again, and finally uploading and submitting. With a slow scanner and poor Wi-Fi, using the suggested time allocation was very touch-and-go. This gave me usual extreme exam nerves and really negatively impacted my performance.

What would you like your lecturers to consider if they were adopting this change in the longer term?
Technology capabilities vary massively across students, so fully-scanned exams need generous extra time. Using a mixture of standard VLE questions (enter a number, MCQs, etc.) and scanned-PDF answers is a great way to solve this. It felt that some exams used time pressure instead of deeper questions to make them harder in an open book format, and I'm not sure how useful traditional recall questions are, because they are easy to look up and so you are essentially giving those marks to everyone. If you really want to push your students to the best of their abilities, make a longer exam (6, 12, 24 hours or similar) with more difficult questions that test a deeper understanding. This style of exam can better represent real life working styles, as well as helping us show how good we are at the subject, rather than how good we are at taking the exam.

Student Perspective 14
Dimitris Boufidis

How did your learning experience change?
This semester, I have worked in a small team of engineering students called 'Anyone Can Engineer', to connect students to diverse careers based on engineering roles they would enjoy, debunk some common engineering stereotypes and inspire the next generation of scientists and engineers. As a team, we have created an educational quick-start guide to help young people explore their potential in engineering, a prototype website and are looking to develop a mobile app too!

Working remotely on this project gave us the chance to develop new skills, work together in a completely different way, and effectively utilise digital technologies. We use Doodle to find a meeting time that works for everyone, despite time zone differences, and Zoom to host weekly meetings. Extensive

meeting minutes and recordings are taken to allow absent members to catch-up. Our meetings take place in the afternoon to account for members in different time zones (e.g. South America). Meeting with external stakeholders is essential to ensure the fundamentals of the project's output are met. Inherently collaborative media was the key to asynchronous teamwork. This ensured that each member could contribute to all aspects of the project by working on a shared Google Drive, and making use of collaborative design platforms like Canva. Modern workplaces require technology to be integrated into teamwork and working remotely helped us develop these skills.

What were the positive things about the change?
One of the main things we'll be able to take away from this experience is a more flexible approach to teamwork. With all the issues we had trying to work synchronously, we learnt to trust each other more and to work asynchronously, through collaborative platforms. It created a better group environment which meant that people could miss meetings if they needed to and make it up in their own time. We believe this increased the creativity and motivation of the group, as everyone was equally responsible for the outputs. The organisation became more important as well. From keeping the shared Google Drive clean and easily accessible, to recording meetings and staying on top of meeting agendas and minutes, it was so much more important to document the decisions that were made because circumstances changed quickly. Staying organised has become a habit which will be invaluable in the future of work.

What did you not like about this change?
The lack of face-to-face interaction was hard. As we met first outside the project, we knew each other well and would see each other regularly in lectures and other projects. Changing from that sort of familiarity to only seeing each other in meetings was difficult, and at the beginning was a little awkward. We began to implement five minutes of chit chat before the meeting started to maintain those relationships, and are looking into doing some online social activities so we don't only meet to work. However, this isn't quite as good as being able to have a physical meeting and so we look forward to being able to meet face-to-face more in future.

What would you like your lecturers to consider if they were adopting this change in the longer term?
One of the greatest challenges, that eventually became an asset, was the ability to be flexible. As a team, it helped us to understand different situations better, so, if this approach could be used more by lecturers, it would take a lot of the

stress out of having to work virtually. For lecturers, this might mean ensuring that all lectures are recorded, easy to find, and posted as soon as possible. It could mean a growing reliance on 'discussion boards' to ask lecturers questions. A lot of lecturers do attempt this already but often aren't used optimally. The lockdown has made us realise that some tasks are better done without face-to-face meetings than others. In the future, we would like to continue using these methods along with traditional ways as and where possible to continue our activities.

Student Perspective 15
Samuel Casadei

How did your learning experience change?
I am an interactive learner, and so being able to physically see the lecturers, and have a high level of interactivity is something that I greatly value. Most taught lectures and labs have been converted into online resources, including live lectures, as well as pre-recorded ones. The vast majority of tutorial sessions were not run, because of lack of student attendance, which made it harder to ask questions. Overall, I think the changes were good, and assessments were also changed to open book, interpretive assessments instead. Some of my modules just gave out the original assessments, rather than adjusting them, which I feel was counterproductive to testing application of knowledge.

What were the positive things about the change?
I think that moving online makes the lectures more accessible, so that people who are socially anxious feel more open to ask questions and so benefit from remote learning. The modules that changed their assessments were by far the most positive change. One module in particular designed a threshold test, which allowed us to test that we met the basic knowledge requirements for accreditation, etc., allowing us to attain 40% of the module. Then, we had an open book, interpretive question paper, which allowed us to demonstrate that we can actually apply the knowledge we have been taught, and not just regurgitate facts. I think this method should be made compulsory across all modules, to ensure consistency across the board.

What did you not like about this change?
As stated previously, I am an interactive learner, so for me there is no replacement for practical lab activities. I feel like the replacement options were suitable to demonstrate the key knowledge – mostly just showing the

applications of what we learned in lectures – but normally in labs, something 'clicks' while doing the activity, and cements the lecture content. This doesn't seem to happen with replacement labs. Also, generally, there was a lot of ongoing confusion about assessments. This is likely due to the fact that I am doing an interdisciplinary degree, and so communicate between multiple departments in the faculty. But, overall I feel there should have been more of a faculty-wide approach to communication and assessment, rather than each module leader deciding their own course of action.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I would like lecturers to truly rethink the assessment types going forward, making them clearer and more defined, along with more interpretive assessments, which mitigate issues around open book exams and collusion.

I think the online lectures do work well, and do allow sufficient interactivity. I would like to see more use of quizzes generally, because not being in university and around coursemates makes it easier to lose track of learning, so interim quizzes would mean that we can keep track, and make sure that we are taking away the necessary information from the lectures.

I would also like it if there were 'worked examples' for a lecture, written out and provided before the lecture, rather than trying to draw equations with a mouse, as this was more of a distraction than anything. Overall, though, I think the adaptations have been well thought out, just a few minor issues to iron out.

Student Perspective 16
Kayleigh Crosbie

How did your learning experience change?
As a student on a taught Master's programme, my learning experience changed in different ways as a result of COVID-19. For some of my modules, material was taken completely online using recordings of lectures from previous years. One module, however, has always been more interactive in its approach with team-based learning throughout its lectures. For this module, the lecturers held the lecture live on Microsoft Teams, and also created each team a separate group on Teams so that we could split from the class and work as a team on activities given in the lecture. Another area that has changed is my dissertation, where the project itself has been changed from being a practical study to a simulation study. Here, I have again held meetings with both my supervisor and the company involved in the project using online communication.

What were the positive things about the change?

The change to learning online resulted in a better relationship with lecturers because of one-to-ones being easier to organise and attend virtually. This is a result of both the lecturers not moving from one building to the next to hold lectures, but also because students are able to have the meeting without travelling to the respective office. Lecturers at the University have been very accommodating and willing to hold virtual meetings on request. Organising an in-person meeting, often feels like a lot of effort for a small question. However, having the meeting virtually means that it can be held and solved quickly, proving time efficient. Also, as a result of the Microsoft Teams groups created by the lecturer in our team-based learning module, the lecturers were able to join separate group discussions, see the work we were doing over the shared screen, and give feedback on our progress.

What did you not like about this change?

I didn't like some of the lectures being given as pre-recorded sessions, where there was no input from the class. I found myself having lots of small questions that could have been addressed quickly during the lecture in normal circumstances. I also didn't like the fact that, because some lectures were no longer live, many of the timetabled slots were cancelled and, as a result, I felt that a lot of structure was lost. I understand that some people would have still chosen to watch the recorded lecture at a later time. However, this also gives students the opportunity to attend the lecture during its time slot, be involved with the lecture, and keep a structure if that is what they prefer.

What would you like your lecturers to consider if they were adopting this change in the longer term?

I would like the lecturers to consider keeping the timetable and scheduled classes live, with a recording available. For me, structure is important, and although I have created my own structure, I think if the class worked to a similar schedule, it would help to make you feel more part of a class, rather than somewhat isolated. It would also be good to contribute to online live lecturers without having to talk over the microphone. I found that home situations sometimes resulted in background noise making it difficult to have an input. For this, I would suggest giving students the option to communicate with the chat facility, or to use an anonymous live quiz. The quiz could test the understanding of the lecture with multiple choice answers, or score how well a concept is understood. Individuals can then give further feedback or ask questions, if they want to, over microphone.

Student Perspective 17
Aiden Findlay

How did your learning experience change?
In March 2020, I was forced to repatriate to the UK from Florida, where I was on exchange for the study abroad year of my degree. Returning to the UK meant completing six weeks of the Florida course remotely from overseas. This was challenging, particularly with respect to groupwork and giving presentations. Working from the other side of the Atlantic, I had to stay in constant communication with my professors and group-project teams in the USA in order to stay up-to-date. The five-hour time difference meant this would usually happen in my evenings. The US term dates meant that my exams concluded a month earlier than those of my colleagues in the UK, giving me time to consider how university life had been affected and how it might be improved in the post-COVID world.

What were the positive things about the change?
I was made aware of the webinar series Lasting Impact from Crisis Innovation being run by several professors at my UK university. I was invited to co-host one of these webinars, looking at the impact of COVID-19 on students' employability. Presenting to eighty university academics from across the UK was an inspiring insight into university-level pedagogy and teaching design. It was fascinating to speak with professors about their teaching, an insight few students ever see. This experience made me realise the untapped value of collaboration between students and the academic community. By working with students and using their feedback to improve teaching methods, both learning outcomes and student engagement can be improved.

What did you not like about this change?
The US system of continual assessment meant I was missing deadline after deadline in order to pack up my worldly belongings and fly home. With daily deadlines mounting, I was hesitant to even fly home and disturb my work schedule, as I knew it would have serious ramifications on my degree if I failed any modules whilst abroad.

What would you like your lecturers to consider if they were adopting this change in the longer term?
COVID-19 has derailed the usually rigid structure of university teaching, uniquely bringing students and staff together at a time of separation. In the post-COVID world we have the opportunity to challenge preconceptions about

what traditional university education looks like. The mutual understanding brought about by these exceptional circumstances have been enlightening for both parts of the university community and it would be a shame to lose this respect. Learning design does not have to purely be the remit of lecturers and I believe that considerable value can be achieved from working with students to improve modules and curricula.

Student Perspective 18
Luke Heyworth

How did your learning experience change?
Studying with the Open University means that there has been very little change in the way I learn. The University as a whole has only removed the ability to submit assessments via paper which was not something that affected me. One of the bigger things that changed for me was suddenly having family around to deal with, and trying to maintain the standards that were required by my degree without getting distracted by that change in circumstance. It has been hard, as I find myself distracted easily by others, but by changing up my timetable, I was able to work better earlier in the mornings, before people were awake, and then finish my day earlier.

What were the positive things about the change?
It is good to have people around to bounce non-academic ideas off, especially with internship season coming up. Other than that, little has changed.

What did you not like about this change?
As noted above, it is much easier to get distracted if others are around the house. One of the biggest benefits to studying full time with the OU is the ability to shift work left and right. This has been really useful for me as someone who enjoys travelling for a change of scenery, because I am planning to finish my course mid-summer so that once travel starts to open up again post-COVID-19, I can get on the first plane out of the UK without having to worry about working!

What would you like your lecturers to consider if they were adopting this change in the longer term?
It is very hard to comment on this as I obviously haven't been subject to as much disruption as students in other universities, and although we have tutors, I choose to have very little contact time anyway, and have gotten used

to the self-motivation of getting work done rather than relying on others to give direction. Perhaps I could recommend the encouragement of a healthy work-life balance – otherwise it can get quite overwhelming when the weeks and weekends merge into one!

Student Perspective 19
Leo Huang

How did your learning experience change?
With the COVID-19 crisis ruling out non-essential travel as an option for this summer, I, like many others, have seen my holiday plans cancelled in the blink of an eye. As someone with a great interest in optimising and making the best use of my free time, I dreaded the prospect of an empty and unproductive summer. However, I soon realised that now was the perfect time to develop some valuable skills and boost my employability, something I had originally planned on putting off until my second year. After some brainstorming, I concluded that good written communication was one of the most in-demand skills in today's market, coupled with the fact that it was something that could be developed at home despite the lockdown restrictions. Hence, for the past few months, my side project alongside studying for exams has been to improve my writing skills as best I can.

What were the positive things about the change?
Being able to write well is a highly important skill in the field of engineering. In my quest to improve upon this skill, I began developing new interests and hobbies which I never would have considered before. I knew that it was essential to practise writing on a regular basis, and thus began to browse through my university's media outlets in search of opportunities to contribute. I stumbled across my university's official student newspaper, who just so happened to be recruiting new writers. It's now been two months since I began my role as a Science & Technology journalist, a period in which I've contributed articles and developed meaningful relationships within a warm and welcoming community. Furthermore, these skills helped me to land my first virtual internship at a technology company, where I'm now involved in marketing the company's technologies to various different industries.

What did you not like about this change?
Whilst the COVID-19 crisis has freed up more time to further develop my skills, the situation under which this development has had to take place has

not always been ideal. The fact that the majority of my internship duties can be performed online has been tremendously helpful, yet it is clear that there are limitations for any company which is run one hundred percent virtually. My main tasks consist of submitting write-ups, but the most important and valuable part to my personal development has been my training as well as the post-submission feedback I receive, just as you would improve in your university coursework by discussing and taking in your professor's suggestions. Given that my team managers are in charge of a very large group of writers, it can be difficult to receive any kind of personalised feedback, which is usually compounded by the impersonal nature of conference calls.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I believe that lecturers should place a greater emphasis on the importance of good writing skills in the engineering field, implementing sessions throughout the year specifically focusing on such skills as required. Being able to communicate your thoughts and ideas, particularly in an appropriate engineering style, is vital when explaining to others how certain mechanisms or processes work. Furthermore, lecturers often find that the quality of writing in their students' laboratory reports is not as high as they would expect, yet fail to address the root cause of the problem which is a lack of practice and experience in writing in the required style. Particularly before setting students such a report to write, lecturers should consider the fact that students, especially first years, may have never received any formal teaching or training on how to write. It should not always fall to the students to develop such essential skills themselves.

Student Perspective 20
Robert Hwang

How did your learning experience change?
On 16 March, it was announced that the university was going to wind down face to face teaching and pursue an online method of teaching in response to COVID-19. I felt a sense of fear of the unknown as my fellow classmates and I were thrust into uncertainty about our education and about potential fallout from the pandemic. The next day, this feeling was compounded by the closure of the laboratories and rumours of a military-enforced quarantine. Over the next few days, lectures were quickly moved into an online format, and all laboratory work was cancelled. Despite a few initial technical hiccups, which

were to be expected from such a fast turnaround, both educators and students quickly adapted to the online format, and within a few weeks a new sense of normality returned, at least from an educational point of view.

What were the positive things about the change?
The most impressive aspect of the university's response was the fast turnaround from Government decree to classroom implementation. Although the school was given a week from the initial Monday announcement, my last face-to-face lecture was the same Monday; all my modules were immediately ready to move into an online format by the following day. By all expectations, such a colossal change to education should have caused major disruption. However, I felt that the only disruption was a few technological teething problems due to unfamiliarity with the teaching software, and only lasted the first few days. The decision for teaching to occur at the normal timetabled time was excellent, as this helped provide a sense of continuity to the term, and a faster return to new normality. Overall, the quality of online teaching provided was on par with that expected in face-to-face teaching. I felt that there was better accessibility of lecturers in the online format, through email and the raise hand function in the software used in online teaching.

What did you not like about this change?
The least enjoyable aspect of online teaching was the complete lack of experimental laboratory work. All laboratory work for both my project and modules was cancelled. Frustratingly, I had insufficient data to complete my project and was provided with mock data for my modules' coursework. Although this was accounted for in terms of assessment, this resulted in lack of comprehension of the experimental work for the modules, as I felt that I did not truly understand the experimental methodology and thus the experiment from the lab sheets and videos provided. Other unenjoyable aspects were uncontrollable. A major reason why students normally choose to attend lectures in person as opposed to watching back recordings is for social contact with other students, and sense of belonging. The compulsory online teaching format removes this choice from students making you feel powerless and isolated.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I would like the lecturers to carefully consider and review the delivery of the practical aspects of the course. As it stands, I do not feel that reading, and watching limited videos, is conducive to true comprehension. Perhaps if possible, running more lab sessions with social distancing in place may be an

option to aid comprehension.

Another aspect handled well by my department was the clarity and constant updates about assessment. This worked well to alleviate education-induced anxiety. I implore lecturers to continue this to the best of their ability. What worked especially well was informing the students not only of what was happening for certain, but the possibilities for assessment which the faculty had narrowed the choice down to.

Student Perspective 21
Reuben Mitchell

How did your learning experience change?
Starting your first engineering job can be daunting, and was made even more so by the fact I had to do it all remotely. At first I was worried my internship would be cancelled or at very best postponed. However, Tribosonics decided to give the internship a week trial period. This week would decide whether an internship would be beneficial to both Tribosonics and me, and would give us a better understanding of how we could make an internship work in such strange circumstances. I understood that there was absolutely no obligation for Tribosonics to hire me, so the fact that they blessed me with this opportunity, and ultimately extended it beyond the week, motivated me to prove my worth and showcase my potential. My experience changed from working in an office to working from home, attending video call meetings and needing to work independently as I couldn't solely rely on 'asking whoever is closest'.

What were the positive things about the change?
This change really inspired me as I knew Tribosonics must see something in me to have even considered attempting an internship during this time. They gave me a week-long project to work on and I put my all into it. I worked 10-12 hour days ensuring I kept up communication by sending daily updated 'scope of work' documents to the employees I was working under. I made sure that not only did I meet deadlines but I beat them, and I didn't have a 'that'll do' attitude: every document or program I wrote was to the best of my ability. Working from home allowed me to focus and work long hours without having to worry about things like the time it takes to travel to and from work or getting interrupted when you are in a focused mind-set.

What did you not like about this change?
Communication was much harder. Especially as a new employee, I had a lot

of questions and that meant a lot of phone calls. In addition, the general team-like feel was missing and it was sometimes hard to see the bigger picture, as I didn't know the other projects the team were working on. Having said this, I continued to work for the company after the trial week, and was able to get involved in more team-like activities. This included weekly meetings to discuss what projects are going on within the company, and also meetings to brainstorm new ideas, inventions and markets. However, my favourite 'meeting' was when each member of the team opened their care package sent by Tribosonics as a thank you for their continued hard work and dedication. All of these helped add to the team-like atmosphere.

What would you like your lecturers to consider if they were adopting this change in the longer term?
In my opinion, the way Tribosonics and many other companies are operating at the moment can be applied to universities. It is important to trust that each student will work the best they can, and offer support that is tailored to each individual. This might include offering 10 minute bookable slots that set aside time for an individual to receive help from a lecturer. In addition it's important to note that within a company it isn't the CEO who is responsible for everything. They have leads in specific areas such as engineering, PR and finance. Likewise in universities it shouldn't be the lecturers doing all the teaching. Assign a handful of volunteer students to be the leader of particular subject areas. For example, Person A is who you speak to if you are stuck on a relative motion question, whereas Person B is the go to guy in Matlab programming.

Student Perspective 22
Shivansh Mittal

How did your learning experience change?
As a final year student, with a few months left on my project, I think my learning experience changed little with the transition to online learning. My project was largely computational and supervisors/assessors were responsive to communications. Personally, though, I think it has a greater impact on those taking exams and earlier years, as the university process has become less about education and more about a lifestyle experience. With a shift to online, newer students will not obtain the 'lifestyle experience' and will therefore suffer relative to previous years.

What were the positive things about the change?

Cheaper to study; increased study flexibility; increased time available in a day (because of reduced commuting time); reduced stress (due to increased time and flexibility)

What did you not like about this change?

Severely reduced productivity; reduced opportunities for social interaction – for obvious reasons, but also to enhance breadth of study (sometimes, when you talk to others, they come up with ideas for your project, or you get an idea); reduced opportunities for sports (clubs, university gyms, etc.)

What would you like your lecturers to consider if they were adopting this change in the longer term?

Recorded lectures are incredibly useful; responsiveness to Emails is paramount; students may be less productive; hours may be more inconsistent; FAQ development would be useful (common questions which lecturers answer every year as a resource for students to look up). Potentially, if a lecture is recorded and played over a few years, the time saving in lecture preparation and delivery could be used to answer students' questions with more detail.

Student Perspective 23
Zak Nicholls

How did your learning experience change?

My learning experience changed dramatically throughout the COVID-19 crisis. All the assessments for my modules changed from prior to the pandemic. I had some formal exams changed to online assessments with a multichoice part and then a written part, both allowing completion any time in a 24-hour period. The crisis pushed my learning back by about a month while the plans changed and the period of change for the assessments took varying lengths depending on the module.

What were the positive things about the change?

The positive about the circumstances was that we were able to manage our own time and do the lectures when we felt we were ready to move on. No content was missed when going back over the lecture, all the working and knowledge which was required was shown on the lectures, whereas, in lecture theatres when lecturers write on the blackboards this cannot be seen in the lecture recap videos and this can cause some confusion as content is missed.

The exam timetable allowed me to take the exam any time within a 24-hour period, so I could choose whether I preferred a morning or afternoon exam. This choice alleviates some stress and anxiety for afternoon exams. Afternoon exams allow for revision in the morning, which can be good but also cause stress if you start to believe you don't know enough.

What did you not like about this change?
I did not like the fact that we were unable to speak to the lecturers as easily and this made the learning experience very different. Gaining help and understanding on problems/tutorials was a lot harder and meant a lot more time had to be spent on understanding how to answer the questions. When the lecturers used PowerPoint shows with speaking on them, it was a lot harder to stop and start part way through a slide with a lot of talking on it. When the lecture is done as a video you can start and stop whenever you want making it easier to study and understand the content. Some lecturers did not give slots to ask questions on Blackboard [the VLE] like they do in normal circumstances in tutorials, making the learning very independent and complex, with minimal help on the problems.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I would like my lecturers to look at how they changed their modules to fit this environment, and the opportunity it provides moving forward to change the way the modules and assessments worked. There were some benefits to the new curriculum, but there were also some negatives. If the exams are to be done online in the future, they need to change so that they aren't based on memory but are based on application, as this is more realistic for the working world. The crisis can be used as an opportunity to realise the online ways available to improve lecture teaching. Problem solving exams would allow for content from several different modules to be assessed together, further developing engineering skills.

Student Perspective 24
Jash Pandya

How did your learning experience change?
COVID-19 caused major changes to the way content is delivered to students, but did not necessarily downgrade it. Online, recorded lectures made sure we gained as much theoretical knowledge as we otherwise would have. The worst affected

parts were the tutorials and the lab sessions, and lastly, on a personal level, the change due to COVID-19 reduced my work efficiency and discipline. This was due to multiple factors, some of them being the time difference between India and the UK, and the comfort of being at home, rather than in a university dorm.

What were the positive things about the change?
On the positive side, being alone in a room and listening to lectures definitely allowed me to pay more attention and be more focused, as it removed the distractions present in a classroom. Moreover, the greater flexibility in terms of time to approach the lecturers for doubts and questions made it easier for me on a personal level. Lastly, there were a lot more resources available online which could be accessed anytime; being someone who generally studies later at night this gave me more freedom than I would have otherwise had.

What did you not like about this change?
The worst affected parts were the lab sessions and the tutorials. Pre-COVID-19, I used tutorial sessions to understand concepts which I couldn't grasp through videos and lectures. Although sufficient arrangements were made by the university, the move to digital learning made it a lot less effective for me. Lastly, the for the lab sessions, the laboratory teaching team at the University were really amazing to provide all the sessions through online media, but the core essence of a lab is lost during the same process – exercising it by hand makes it more intuitive, and provides a far greater learning experience when compared to online labs.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I feel the students should be given some more relaxations in terms of assignments, as some of us are more affected than others. Moreover, the living conditions may vary vastly, and the privilege of having isolated study spaces might not be accessible to all students. Core subjects like mathematics are more difficult to understand through a screen when compared to in-person. I feel factors like these should be taken care of, while of course making sure the quality of education isn't affected.

Student Perspective 25
Tahira Resalat

I recently completed a year-long internship at Dyson, in an upstream research

team, and my experience in the company has undoubtedly been an excellent experience in starting off my engineering career. I graduated from the University of Sheffield as a materials engineer and with my career interests focused in product design, I went on to pursue this internship to help bridge the gaps I felt existed between my degree and my dream job.

Throughout my internship, I have developed a thorough understanding of user needs, behaviour characterisation, linking user perception to performance, and putting users at the core of product design. These were all skills that were very different to what I spent my undergraduate degree learning. This apparent difference, which my internship helped me to see, was important for me to recognise.

Materials science was a very theoretical degree, and though I enjoyed it, I'd always been intent on its more applied aspects. My placement gave me the chance to experience an environment I never had before, and to pick up skills I previously hadn't developed to the same extent. The "people skills", an umbrella term to describe workplace etiquette, stakeholder engagement, flexibility, problem solving, communication, responsibility and leadership, I learned throughout my time at Dyson are something I will take on with me wherever I go. These are not skills I've had to work through at university.

The problems we solve at university almost always have a solution – ones that you work through with coursemates or that your lecturer can often help you through. At work, this is different because in many cases, the solution doesn't exist till you come up with it. This gives you a lot more responsibility over your work. There are real deliverables involved, with hard deadlines. People are reliant on your work to do theirs! While daunting at times, it is also an amazing way to experience responsibility and accountability first-hand – the success of which can be very rewarding. There are often many (senior) stakeholders who you not only have to present your work to, but also engage while doing so. This requires a lot of confidence and effective communication skills. All in all, these are all skills that I definitely give credit to Dyson for helping me develop!

Going forward, I would like to see the elements of internships highlighted above to be more readily accommodated into course content on engineering degrees. It goes without saying that context heavily plays a part in actualising the effectiveness of these skills. Although it will be difficult to replicate the 'professional environment', which working in an office or industry easily allows, it will greatly improve the overall experience of students. We are all problem solvers and having real deliverables and stakeholders allows students to learn the responsibilities involved in project work while also feeling rewarded when seeing them into fruition.

Student Perspective 26
Michael Sobodu

How did your learning experience change?
My learning experience during the second semester of my third year mechanical engineering dramatically changed due to COVID-19. I began isolation in the first week of March, due to having two people vulnerable to the disease in my household. Prior to this, I had been attending lectures, meeting with my project supervisor, and using the library facilities to study. This was changed to remote study from home, using online resources supplied by the university.

What were the positive things about the change?
The positive aspect of the change was that travel time and costs were obsolete. It was also good that I could watch lectures at my own pace and also give feedback to my tutors via module fora. The mock assessments were also a good way to be confident that technical issues would not occur during the exam period.

What did you not like about this change?
The change brought a deceleration in the progress of my third year project. A colleague was adjusting to the pandemic during a critical time in my thesis, which caused me to make a change to my project. It was also relatively difficult to study at home compared to facilities at university, but due to the high risk nature of my household this was not possible. The fora were a good source of information, but sometimes influenced me to search instead of directly asking a question. The absence of online problem solving classes was also a displeasing factor.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I believe adding interactive elements (e.g. Kahoot, etc.) to an online lecture would be a benefit to remote study in the future.

Student Perspective 27
Stephen Soleye

How did your learning experience change?
I was fortunate because I did the majority of my modules in the previous semester so I was only doing one module aside from my dissertation. The

change in my learning experience was extreme because the module involved lab and practical-based learning in programmable logic controllers. The change in learning meant that there was more reading and very little practical-based work. It was difficult to see how the theory worked, and even more difficult to get accustomed to the SEMANTIC software which I was learning. I had to rely on videos and the lecture notes a lot more. For my dissertation, my learning had always been independent, however a lack of equipment to manufacture my project meant that I had to make use of what was around me. Luckily my project was Arduino-based and involved electronics, which meant that I could easily adapt to working remotely.

What were the positive things about the change?
Independent learning was a positive outcome for me. Although, I could not carry out the practical aspect of the programmable logic controller module, reading, and trying to fill in gaps, meant that I was trying to really understand what was going on, which led to a strong theory foundation for me. It also meant I utilised the learning resources a lot more because I was dependent on them to grasp an understanding of the module.

What did you not like about this change?
Aside from the lack of practical work, I did not like a few things. The lecture notes were step-by-step based on how to utilise the SEMANTIC software. I found learning with this to be time consuming because two pages of information could have been condensed in a 30-second video or a 1-minute lab work. I found it best practice to watch the video tutorials released as well as the lecture notes but it did not feel as good as carrying the work out on my own. I also felt that I could not easily gauge the depth of my understanding of the software to know if I could utilise it in a graduate role once I was finished. This meant I was less confident in using my learning in real-world applications. The assessment was a multiple choice, timed quiz, which predominantly tested theoretical knowledge and some practical knowledge.

What would you like your lecturers to consider if they were adopting this change in the longer term?
I would suggest providing a way to make the labs virtual. It would be fantastic to be able to still utilise the software remotely and have a virtual model that reacts to the software code. This would mean that practical learning is still possible regardless of being physically present. I also feel that lectures could pro-actively provide an opportunity, like a one-week or two-week crash course, if possible, for students who really want to carry out practical learning once it's possible to do so.

Student Perspective 28
Henriette Stainer

How did your learning experience change?
This past academic year, I have been doing a year in industry at InnoTech Alberta in Edmonton, Canada, in collaboration with the University of Alberta. I was conducting an individual research project, assisting in others, and researching literature for project proposals. One project led to my first published article as a co-author. Due to COVID-19 my time was cut short, and I had to return to the UK. Consequently, I could no longer continue to work on the project in the laboratory. To bring the project to a close, the preliminary findings will be published to stimulate further research in the area. Working from home my role became more research based, looking at literature and other available information to support project proposals and projects continuing at InnoTech Alberta.

What were the positive things about the change?
The pandemic had a large impact on all parts of everyone's lives, but not all of these were negative; for example I learnt to construct my own schedule, which I could work with and adjust to discover how I worked best and most efficiently. This had a very positive impact on my well-being, as it allowed me to pursue new ventures in my own time, such as starting an online course about sustainable development, to further my education in areas of interest. Additionally, I have been able to reflect and identify skills I want to improve to increase my employability. I have also taken up new hobbies, such as embroidery, where some of my old ones were no longer available.

What did you not like about this change?
Despite the positive experiences I have made, I would like to address some of the drawbacks that have occurred due to the change. A large drawback was having to move back to the UK prematurely, as I could no longer complete the individual project, which could have potentially led to my first published research paper as main author. Furthermore, I am missing out on time working in the laboratory, learning new skills, and improving on others. Last but not least, I miss the life I had built up for myself in the 6 months I was in Canada; I went on trips to the Rocky Mountains hiking, skiing and camping, a trip camping and surfing in California – all with the University of Alberta Outdoors Club. I took up new hobbies I had not considered before, learning to climb, skate and ski, and joining the university swim club. Throughout all my activities I made friends with people from Canada and across the world.

What would you like your lecturers to consider if they were adopting this change in the longer term?

Heading back into the final year of my degree, I am expecting to conduct most of my studies from home, and there are some points lecturers and educators should be aware of if they are not already. Learning to self-motivate, self-discipline and construct your own schedule and keep to it is challenging, especially when one no longer must leave the house to attend lectures or tutorials. It can be a long process of trying different methods to find out what suits one best. Whilst university buildings are closed or have limited access, some students may not have access to tools and equipment that could aid them in their work, for example establishing the right home work station – which many employers have been providing for their employees. Working from home can also be very isolating, therefore I believe it is important to uphold communication between students and educators.

Student Perspective 29
Kevin Suarez

How did your learning experience change?

For me, being at home has allowed me to focus more on my university than when I used to go to university campus. This is because of the early times and travelling time, as well as costs I needed to spend to get to university. This does not mean it was better. I still believe having your teacher in front of you allows you to answer questions in a better way.

What were the positive things about the change?

I had more time to focus on my studies.

What did you not like about this change?

Some teachers decided to just make us watch previous years' recordings, as they explain better on those videos. I did not like my physical and mental deterioration from being at home every day.

What would you like your lecturers to consider if they were adopting this change in the longer term?

I am very afraid for future generations, because teachers think that something is easy when it is not, and they attempt to go fast on the topic, while students struggle to understand the beginning. One of my teachers had a different approach: he showed us, from the beginning of the semester, all the steps

to answer and understand all calculus and theory questions, including the hardest ones. He ensured all questions were correctly answered, and even gave extra, updated slides so we can understand fully all concepts. Some other teachers seem to be very busy and so they rush to the end, finish 1-2 weeks early, and then expect us to fully understand all topics of the module.

Student Perspective 30
Thomas Thomas

How did your learning experience change?
All my lectures were changed from face-to-face to online, using Blackboard Collaborate Ultra. All the labs were cancelled except one, where we watched a video to show the practical we would have done. They then provided us sample data and required us to produce a post lab for this. A group project-based module's assessment was changed from creating and testing the robot we were making, to fully designing the robot and producing an online presentation including all members. Any extra-curricular projects that I was part of were mostly cancelled. Some were able to work with online guest lectures and seminars.

What were the positive things about the change?
One good thing about the change was that I could manage my time better. As I was at home, it was much easier to get a nutritious meal in between a packed day. I would otherwise have to resort to a meal deal. This applied to other aspects of my work-life balance. I spent less time moving around and had more time to tackle more things. I found it much easier to ask questions during lectures because of the online nature of the lecture. People were less scared to ask a question, as they were not surrounded by people. I personally feel that the fear of messing up is reduced. The change also allowed me to attend events, and talks from people all around the world. More of these seminars were more accessible.

What did you not like about this change?
One big way that I learn is through practical experience. I found my best work to be done through mistakes that I figure out by myself, or from asking for help, reflecting on my mistake, and fixing that mistake. I also missed being able to work in group studies. This was an integral way of my studying. It allowed each of us to motivate the other. This was much harder with all my friends being in different households in different cities and time zones.

What would you like your lecturers to consider if they were adopting this change in the longer term?

I think that lecturers should give a chance for more questions after the lectures. There are many reasons why a student would not be able to join the lecture live due to time zones, Internet connection or unexpected family commitments. One way that lecturers could try addressing this is by providing a place for students to ask questions about the lecture afterwards. This could then be followed by blocking out the first 10 minutes of the next lecture to answer questions that could not be answered with a reply. Another thing the lecturer could integrate is guest lecturers. It would be great to bring people in the same industry to give their lecture and give us perspective of why we are studying these specific topics.

Student Perspective 31
Thomas Thomas

How did your learning experience change?

During the pandemic, the University stopped any form of face-to-face interaction between the staff and students. Following the rules set by the Government, all buildings were also shut. This closure impacted lots of extra-curricular activity. For example, I am the Arm Project leader of Sheffield Bionics Society, and my team as well as the other projects in the society were not able to meet in person after the University closed. We had our AGM in April, which was when I was elected as the new Arm Project leader. We still met weekly meetings and some subteam meetings using Google Meet, as we had to prepare for the CYBATHLON competition (a race-based competition for different prostheses like arms, legs and wheelchairs). Due to this facility we were still able to meet and work on anything that was purely software related. However, this was limited to designing our arm, understanding lines of code, designing our website and other administrative work.

What were the positive things about the change?

During lockdown, we focused on creating a brand for the Sheffield Bionics Society and publishing it through our new website and social media. We also found, and connected with, an upper limb amputee, after we had been looking for a partner for some time. Through this collaboration, we learned what an amputee really wants from his/her hand, like a socket that is not too tight, and not about having full control over all the fingers of the prosthetic to move perfectly and accurately. We were forced to restructure and declutter our data.

To work online efficiently, it was a necessary evil. We made folders in our Google Drive for admin work, a Fusion 360 shared folder for the structure team and a shared GitHub for the firmware team. Another thing that we found good during this time was the availability of people – not just the team members, but also former members of the society who could give us their insight and experience from the society and their current work. Having quick crash courses on essential skills for the project were run by them alongside the senior members of the society. This would have been much harder if there wasn't a lockdown. Overall, the lockdown forced us to be creative and it was quite reassuring how well we worked, given the circumstances.

What did you not like about this change?
One frustrating thing about the lockdown was our inability to work physically on the hand development. We had a 3D printer, but because the iForge, our student makerspace, was closed, we did not have any of the small things like a specific glue or nut that was so easily accessible in the iForge. We also could not just buy kits of these as we only needed one or two each and more importantly, our funding was taken away due to financial constraints on the university. Another problem that we faced was that the sensors and the needed accompanying electronic components were not with the team members who knew how to use them. It made life slightly harder as we had to code for a Raspberry Pi and set a sensor by working together through Google Meet. This had to be done between the firmware team members and the person who had the Raspberry Pi who had zero coding experience! Finally, I found it difficult to use bringing in techniques with more silent team members through a Google Meet. Asking the most important questions in Google Forms did help bring their opinions out in certain situations though, but not all.

What would you like your lecturers to consider if they were adopting this change in the longer term?
One essential thing that needs to be done is to give access to a workshop. While we can have all our meetings and complete designs online, we cannot build the arm. I think a space where we could book a time slot to work while adhering to social distancing needs would be good. I also believe it would be good for the team to be given access to Blackboard Collaborate for meetings. It is much clearer than Zoom or Google Meet when I used it to talk to our academic lead. This could also be coupled with workshops to provide tips to the different societies on tools available and a platform for the societies to collaborate with each other.

Student Perspective 32
Siddharth Vasudev

How did your learning experience change?
As a result of the COVID-19 changes, in person labs became online labs. Instead of actually setting up and using oscilloscopes and electrical circuits, we were just running MATLAB simulations, and watching videos of the lab activity. The university made the most of online features, such as progressive release of exercises – that is, only after finishing exercise one correctly can you get exercise two. Instead of writing down answers blindly to get done with the lab sessions, we are given a 100/100 requirement to complete the labs, with multiple attempts, which is good!

What were the positive things about the change?
The unlimited attempts and progressive release of exercises helped us to understand how to work through each exercise and this enables us to achieve all the learning objectives unlike in the in-person labs where you can get things wrong. Since you need to score full marks to pass the lab, given that you have unlimited access to your notes and textbooks, you end up truly understanding what it is you're doing and learning more about that topic. It helps your understanding better than just completing the in-lab sheets just to complete the lab. Maximum effort was made by the university to make the experience similar. Hats off to the lab assistants for making this possible. It was also a good experience learning to use MATLAB better. We also got feedback after attempts immediately, often this is not provided in in person labs

What did you not like about this change?
I did not like the fact that we did not have to physically set up circuits and equipment. I couldn't be part of the set up of the equipment and that would help me to learn more about the equipment and the minute details that one may miss out when setting up the experiment next time. I wasn't able to ask more questions upon inspecting the equipment that we are using. Maybe a game or design activity such as match the options, or label the diagram, would've helped build that practical knowledge of dealing with lab equipment

What would you like your lecturers to consider if they were adopting this change in the longer term?
I would totally abide by it, as long as my tuition fee is reduced from c.£22k. I like it this way, as you can work at your own pace, but still have the pressure of getting things done. Keep it unlimited attempts, keep it progressive marking,

design some more interactive videos/features, including augmented and virtual reality, to help us get the best experience.

Student Perspective 33
Jacob Whittle

How did your learning experience change?
Assessment has pivoted, understandably, toward online-based examinations and submissions. Each of my previously physical exams has been altered in a different way, but the fundamental outcome and process have remained similar to 'normal'. My coursework submissions have also been altered. Despite some initial concerns, I think these have mostly been done in a fair and understanding way. However, the groupwork that was in place this semester was expected to continue. Clearly, online collaboration is not as powerful or productive when working on group projects; particularly when group members are not friends or in regular contact. I do not think this was handled well or fully appreciated by some lecturers.

What were the positive things about the change?
The most positive thing about the changes to my assessments has been that I actually now feel more confident in undertaking them. This is because the pressure of memorisation and repetition has now been alleviated, and I can now focus on demonstrating and applying my understanding without fear of forgetting supposedly trivial facts or formulae. I have always had the opinion that essays or open book examinations, when done right, are much more powerful and effective methods of assessment, and so it is nice to see this confirmed in some way.

What did you not like about this change?
Although I cannot really blame or have any qualms directly with any individuals, nor the eventual outcomes, I do believe this situation, and the assessment changes it has forced, could have been handled much more effectively. Information, choices available, and the final decisions could have been conveyed to students much earlier in the process. This would have alleviated many of the rumours and stress-related issues that have been so present throughout this time.

What would you like your lecturers to consider if they were adopting this change in the longer term?
As alluded to above, I believe that this situation could have been handled

much more effectively by some lecturers as well as by the university as a whole. Keeping students and staff informed properly with the facts and available options in an open manner would result in a more trustworthy system, whilst allowing decisions to be made much earlier. If these online changes become more long term, it is key that the assessment needs and formats are confirmed and detailed much sooner than they have been this semester.

Student Perspective 34
Jincheng Wu

How did your learning experience change?
I am a Master's student. Before March, I was preparing a microalgae cultivation experiment for my MSc dissertation, and planned to use the experiment data to verify a model we built. We finished almost all the preparation works, ordered apparatus, medium, and seed, and got the approval of school. Unfortunately, the lab was closed suddenly, so I can only do the modeling part of the work, but I got more time to do literature review.

What were the positive things about the change?
Until June, for Master's students, we have no chance to go back to the lab, and have no chance to do experiments this year. For most one-year Master's students, this is an unwanted experience. As I am going to do a PhD, I was given more time to write my proposals and read more good publications, to enhance my research skill in MATLAB and ORIGIN, and to fix up some fundamental knowledge I need for future research. I benefited a lot from this COVID-19 situation.

What did you not like about this change?
For some things, I do not like this situation. Firstly, I was unable to use the computer in the school library and lab. Some poor overseas students like me had to buy a new laptop to take online lectures, join the meetings with supervisors, and do coursework. It cost me over £500, which is 3-months expenditure for food. Secondly, I do miss the chance to do some experiments and discuss with kind supervisors face-to-face; that is what I pay the huge amount of tuition fee for.

What would you like your lecturers to consider if they were adopting this change in the longer term?
If this situation will last for a long term, and the facilities in school still not

accessible, I will probably stop my study career, and go back to my hometown because I do not want to waste my money. PhD study needs more support from the school and supervisor, which can be obtained in the lab, personal discussion only. That is what I want. Anyway, I hope the UK Government and university will give some help to overseas students like me to overcome this difficult time.

Conclusions & Next Steps

Responding rapidly to the COVID-19 pandemic has not allowed time for detailed evaluation of our approaches in the moment. For students and for staff, the focus has been on finding solutions and pursuing them to make progress and conclude the academic year. The work captured and reported in this volume, then, is to facilitate continued good practice and innovation, rather than educational research or scholarship per se (indeed, these should follow later). As such, it presents a snapshot of some of the teaching and learning engineering educators could deliver, as well as the innovations and approaches behind them, in extraordinarily trying circumstances.

Nevertheless, there is much cause for celebration. This volume demonstrates remarkable success in delivering a response that allowed students to complete the academic year successfully, and the ability of engineering education practitioners to adapt, think creatively, and innovate in learning and teaching. The examples herein show tenacity, resilience, and ability to learn quickly, with a focus on delivering positive learning experiences for students of engineering. That success is evidenced informally through completion of programmes by students, and also in their positive feedback, some of which is presented, in their words, in this publication.

As the 2019-20 academic comes to an end, with the conclusion of assessment and exam boards, it is important to find time, in the brief pause before we turn attention fully to preparations for 2020-21, to reflect on our successes and failures. We need to understand what has been successful, and what has not worked so well – and why – both from our own perspective, and that of students. This understanding will drive our responses next academic year, and into the longer term, as we choose to continue or discontinue using new approaches, even as the pandemic subsides and our 'old' ways of working become a possibility again. Those choices must be conscious and deliberate, for they are what will shape the best educational experience we can provide for students in engineering in the years ahead, and that is likely to be a blend of the old and the new.

We hope that this volume, and the calls to action it contains and represents, will be of value and use to us all, as an practitioner of engineering education,

in highlighting some of those choices, and enabling us to learn from peers as we continue shaping learning for and with our students. We hope, too, that we can all continue to draw on the network and community from which this work stems, as we rise to that challenge.

There are multiple ways in which you can draw on and contribute to that community. Primarily, the *Pioneering Programmes and Practice in Engineering Education* network is a developing space and group of educators that we invite you to join. Find us on the Advance HE Connect platform,[1] and join the discussion – share your ideas, ask questions, and promote your successes in the spirit of the community learning together. Many of our contributors and collaborators are active on social media, via Twitter and LinkedIn, and would welcome engagement on those platforms around their ideas and approaches, and how you might adapt and build on them in your own context.

Our publisher, the Engineering Professors' Council, also provides opportunities for community engagement and networking. The EPC website[2] offers a wealth of opportunities, including keeping the present work as a living resource, with the facility for practitioners to submit further case studies, like those in this volume, to be hosted and made available on the website. The EPC also offers an events programme, a particular highlight of which is the New Approaches work, sharing innovations in engineering education, in collaboration with the Institution of Engineering and Technology.

As we continue to move forward with using different approaches, and they become more familiar to us and to our students, big questions emerge about how we more formally evaluate the impact of our changes; what we should be evaluating and monitoring; how we ascertain the strengths and weaknesses of our approaches, ensuring that they are inclusive; and what the role of students is within the evaluation process. We should aspire to evaluate these changes in the context of the world in which we find ourselves – a world where there is greater appreciation of engineering's contribution to human welfare at a global scale, and where economic recovery will be a decades-long project. The engineers who will catalyse and lead engineering's contribution to that recovery are our current and future students. Our education must attract them to the profession and empower them to be productive, innovative, and equipped to make that professional contribution.

We hope to follow up on these issues with more structured evaluations of impact in a future publication, and welcome ideas and suggestions based on your own approaches. The ultimate question to explore remains whether

---

[1] https://connect.advance-he.ac.uk

[2] www.epc.ac.uk

our current transformations are leading to sustainable and meaningful innovation, and whether – or, more accurately, where and how – the much-heralded radical and rapid changes are here to stay. We believe this depends on the choices we make in the coming weeks and months. Whether or not our response to COVID-19 induced disruption become the basis for meaningful, long-lasting change – and the sector 'emerging stronger' – lies with you and all members of our community.

In 2020, the COVID-19 pandemic has caused an unprecedented amount of disruption in universities. In engineering education, we are rising to the challenges posed by a lack of face-to-face content, closing of laboratory and manufacturing spaces, and the need for unsupervised assessment. In responding to these challenges, we have had to critically review the purpose of many parts of our curricula, and been prompted to adopt approaches to teaching and learning that may in fact be more effective than what they've replaced. We've also reconsidered whether constraints that were previously considered immovable can actually be moved.

This volume presents proceedings from *Lasting Impact in Crisis Innovation*, a webinar series hosted by the *Pioneering Programmes and Practice in Engineering Education* Advance HE Connect network. From April to June 2020, the series brought together colleagues and students to consider and share their learning about our courses and learning environments, and to explore what changes we are making now that can and should be continued into the future, even after we all return to our buildings. The present volume also contains first-hand student accounts of their experiences of the transition, and case studies of emerging good practice from engineering education practitioners.