

# Inclusive co-creation decompartmentalizes the bioscience classroom: flip-flopping of student-lecturer and lecturer-student roles

Professor Jo Rushworth HEBTOY Case Study 2022

## 1. Background and drivers for developing this pedagogic approach

The persistent awarding and progression gaps in Higher Education are a stark indicator of the horrifying inequalities of the (bioscience) classroom. Having been a disabled, mature, international and widening participation student myself, I strive for equality and to develop pedagogic approaches that enable every student to flourish and to feel they belong in the classroom. For bioscience curricula to represent and include all students, why don't we co-create with students in equal partnership, thereby embedding and celebrating their diversity from the outset? Why is there often such a disconnect between what lecturers and students see as excellent and inclusive learning, fair assessment and useful feedback? What if we flip-flopped the traditional student-lecturer roles; could becoming a student be a radical way to improve my own pedagogy by seeing through my students' eyes, and are student lecturers the ultimate way to decompartmentalize and enhance radically bioscience education?

My "inclusive co-creation" philosophy combines Universal Design for Learning (UDL), co-creation and student-lecturer flip-flop (**Figure 1**).

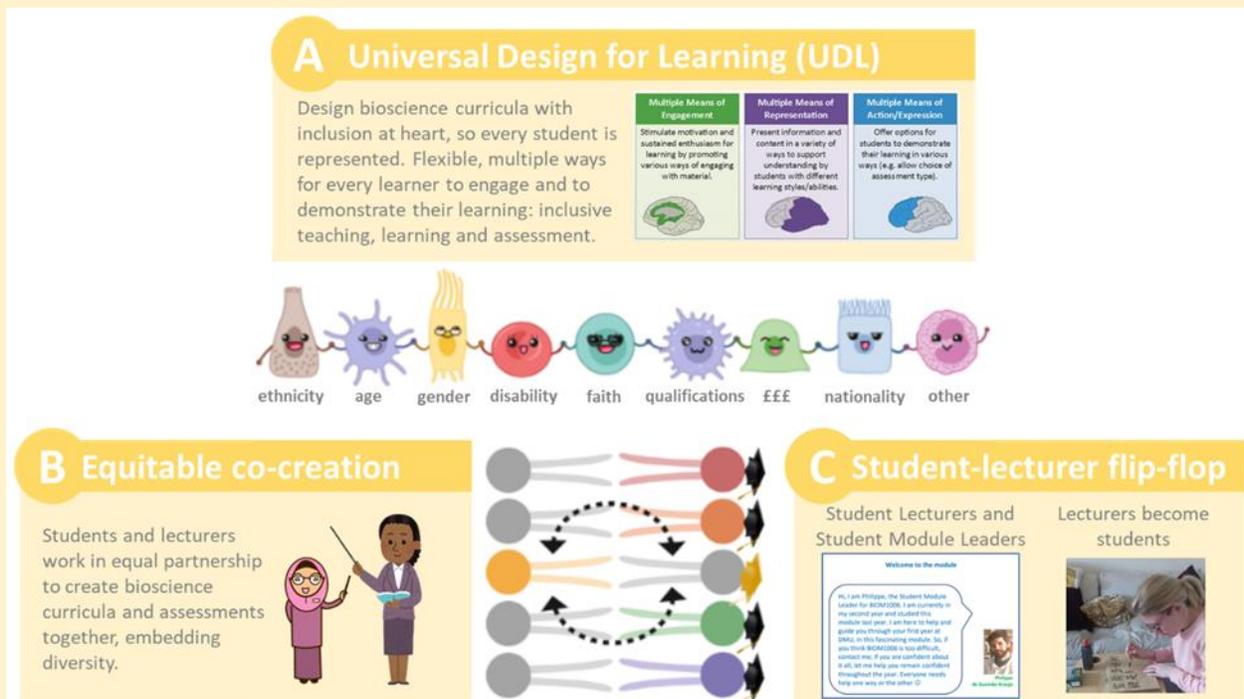


Figure 1. My inclusive co-creation approach is built on three pillars; (A) Universal Design for Learning (UDL), (B) co-creation where students are equitable partners and (C) student-lecturer flip-flop.

Figure produced using BioRender.

## 2. Innovation: approach and evidence of impact

### 2.1 UDL lays the foundations for inclusive co-creation

UDL is a pedagogic framework which enables inclusive, barrier-free curriculum design through promoting flexible and varied options for students to learn and to demonstrate their knowledge and skills (1,2). This approach was crucial for supporting my large, diverse groups of learners at De Montfort University (DMU) (Figures 2 and 3).

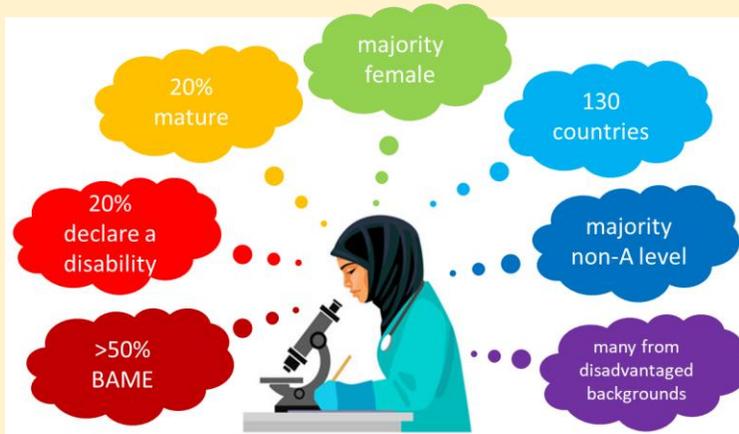


Figure 2. Students at DMU are highly diverse.

Figure 3 is a one-page UDL staff guidance document for DMU staff in 2017. It features the De Montfort University Leicester logo in the top left corner and the CAST logo in the top right corner. The document is titled "UDL staff guidance" and is organized into three main columns, each with a brain icon and a title: "Flexible study resources", "Flexible ways to learn", and "Flexible ways to show learning". Each column contains a list of bullet points providing specific guidance. To the right of these columns, there are three brain icons with accompanying text boxes that provide additional context and examples for each principle.

### UDL staff guidance

#### Flexible study resources

- learning materials are uploaded to Blackboard 48 hours in advance in modifiable and PDF format. Blackboard shells meet DMU thresholds (link below)
- DMU Replay policy is followed. A screencast (minimum requirement of audio with visual) of all academic-led activities is provided
- technical language, symbols and key terms are defined clearly and background information is made clear
- students are encouraged to use scaffolds e.g. concept maps, tables and summaries to link ideas, structure information and highlight key concepts
- wide range of culturally inclusive learning resources is used within which students can recognise their own identities e.g. images, videos and demonstrations
- learning resources from a diverse range of socially, culturally and globally relevant sources are signposted which account for a diverse global community

#### Flexible ways to learn

- varied and innovative teaching methods motivate and engage students (e.g. flipped classroom, voting technology)
- students participate actively in classes and have frequent knowledge checks
- students are encouraged to work in an inclusive and engaged manner with their peers with opportunities for group work, collaboration, co-creation and peer support
- differentiation provides an appropriate balance of support and challenge, with direction to culturally inclusive independent study resources
- students are supported to become autonomous, resilient and reflective learners who can self-check and identify their most effective learning strategies
- learning is authentic and contextualised; it is socially, culturally & globally relevant and takes into account learners' identities, experience and history. Students can identify themselves and their experiences in their learning

#### Flexible ways to show learning

- a variety of assessments besides timed, unseen exams provide flexible ways to meet the learning outcomes (e.g. videos, practicals, presentations, blogs, internet tasks, lay explanations, reflections)
- assessments only test the learning outcomes (e.g. if speed of response is not relevant then don't time the test)
- clear and contextualised marking descriptors are available to students and staff before assessments
- formative assessments and timely, specific feedback and feed-forward help students to improve and excel
- students are guided to set aspirational goals and track their own progress; students embrace mistakes and risk-taking as valuable learning opportunities
- assessments test "real world" problems; assessments are socially, culturally & globally relevant and take into account learners' identities, experience and history

**CAST**

Present information and content in a variety of ways to support understanding by students with different learning styles/abilities.

Stimulate motivation and sustained enthusiasm for learning by promoting various ways of engaging with material.

Offer options for students to demonstrate their learning in various ways (e.g. allow choice of assessment type).

Figure 3. The UDL guidance that I wrote for staff in 2017

As the Faculty of Health and Life Science UDL Champion, I contextualized the UDL CAST principles (3) into this one-page guidance document for DMU staff in 2017 (~3,000 staff; impacting ~25,000 students).

After three years of teaching on the Biomedical Science course, implementing a UDL approach, our **NSS increased by 12%** and I won the Vice Chancellor's Distinguished Teaching Award. However, it became apparent that, despite my efforts to represent and include all students, I will always create curricula (to a certain extent) from my unconscious personal preferences and bias. Why not include students at the heart-and-start of bioscience curriculum design, rather than around the periphery or at the end of the process?

## 2.2 Inclusive bioscience co-creation: a start

I began by co-creating my teaching and learning with a relatively small (~20 – 50) cohort of final year Medical Science students, which we have done for the last four years. We met in Term 1 to discuss and develop the learning plan and teaching methods together. One year, students opted to produce posters and peer-teaching videos in groups; the next year, students selected team-based learning (TBL). During the pandemic, we devised a modified, remote TBL approach that I called CRISPR involving rewards upon unlocking padlocks. Every year, I obtained **100% student satisfaction** in an NSS-style survey and students found the approach inclusive.

*“The process of the way you teach is really great... I have dyslexia and I really struggle with other teachers and their content... how you teach makes it fun and enjoyable to attend.” – Third year student.*

Whilst this is co-creation, I was still in the driving seat. I soon found that when students were supported and empowered to pursue their own projects, they excelled and far surpassed anything that I could have created alone, teaching me valuable skills that enhanced my own teaching (**Table 1**).

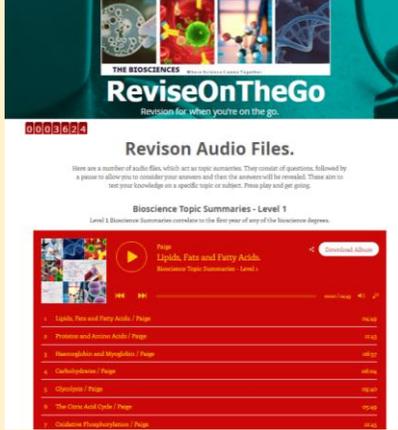
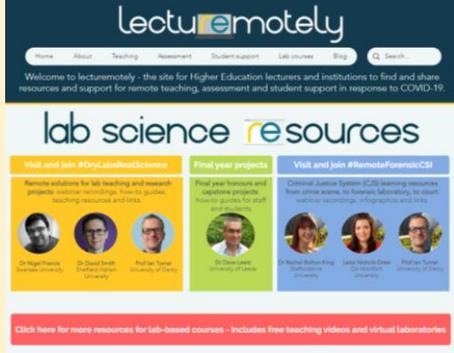
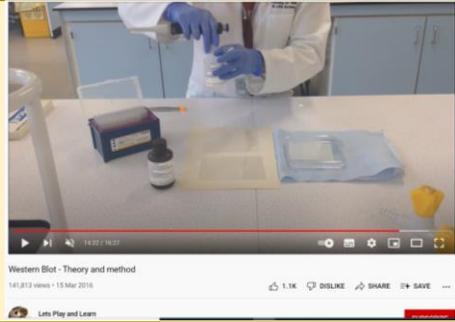
## 2.3 Flip-flop part 1: students as lecturers

Co-creation often describes working with student partners in a shared pedagogic endeavor, in a variety of ways ranging from student representative or consultant to student as producer (5,6). A potentially deeper and braver model of co-creation in which students are equal partners in module co-design and delivery was inspired by my students.

**Philippe de Gusmão Araujo** (BMS graduate) was inspired by the peer buddying scheme which my colleague Dr Jane Sherwood and I had devised. He proposed the idea of a Student Module Leader and in 2018-19 we co-led the Biochemistry and Cell Biology module together. His enhancements included re-ordering the teaching; by teaching some basic biochemistry in a block prior to the genetics and DNA structure, students felt more confident. Philippe recruited Student Lecturers who peer-taught drop-in sessions. More students attended these than my lecturer-led drop-ins! Philippe co-wrote the module handbook, co-led induction, peer taught and co-wrote the module enhancement plan.

Subsequently, as the COVID-19 pandemic catalysed a rapid transition to online learning in 2020, expansion of the student lecturer initiative seemed an innovative way to co-create inclusive, online bioscience curricula. In September 2020, I recruited a team of second year Student Lecturers to work alongside staff on several large, joint modules including my Biochemistry and Cell Biology module (**Figure 5**).

Table 1. Examples of student-led projects and their impact

Student-led project (Biomedical Science graduates)	Impact on students and upon my own teaching	
<p>Paige Tongue built <a href="#">ReviseOnTheGo</a> after I encouraged students to try multi-modal revision e.g. audio podcasts.</p>		 <p>Paige's website is now a widely-used resource by students nationally with <b>3,600+ views</b>. Paige introduced me to Wix websites which helped me to create <a href="http://www.lecturemotely.com">www.lecturemotely.com</a> (<b>16,600+ views</b>).</p>
<p>Brandon Moulds worked with me to create video podcasts of lab techniques, hosting them on his <a href="#">Lets Play and Learn</a> YouTube channel.</p>		<p>Brandon's channel has <b>3,300+ subscribers</b> and <b>452,800+ views</b>. Our western blotting video has <b>141,813 views</b>. Brandon taught me to use Open Broadcaster software which I used for flipped classroom teaching.</p>
<p>Sam Charlesworth created the <a href="#">univerCELL</a> PlayStation game for his dissertation project under my supervision.</p>		<p>Sam presented his game to <b>~120 people</b> at the Playful Learning Conference 2019 (Ref K). UniverCELL increased significantly first year students' grades on a cell biology test with no significant differences around achievement or enjoyment based on students' gender, age, ethnicity. Manuscript in preparation. Sam inspired me to offer future dissertation students the opportunity to create UDL-based games (Ref A,B,I).</p>

### Who and how?

- Second year students who studied the module last year
- Recruited in September – any student could participate
- Unpaid and no fixed expectations; students could do as much or as little as they wanted
- Received some training around teaching (and remote teaching), UDL.

### Examples of activities

- Co-creating teaching and learning materials
- Co-creating assessments, rubrics, unexamplars
- Teaching, drop-ins, revision, quizzes, competitions
- Subject-based and pastoral support, induction, buddying

### Dissemination and feedback

- National & international conference presentations

- Publication (manuscript accepted, under review) co-authored by three student lecturers

"So good to see this level of engagement & involvement from students, engagement seems to beget more engagement" / "Excellent presentation, especially by the student lecturers. The benefit to them and to the courses are clear"

Figure 5. Student lecturers, examples of their activities and dissemination

## 2.4 Flip-flop part 2: lecturer as student

To experience directly what it is like to be a student, and to reflect radically upon my own pedagogic and pastoral approaches, I wanted to become a student myself (**Table 2; to be elucidated via presentation**).

Table 2. Learning from my own lecturer-as-student experiences

My lecturer-as-student experience	Key learning points and surprises > transforming my pedagogy	Evidence of impact and dissemination
<p><b>Being a meta-analysis dissertation student (2017-18):</b> attended my colleague Dr Kim Fisher’s lectures</p>	<ul style="list-style-type: none"> <li>• I felt self-conscious; most students had a maths A level. How can I make my students feel more confident?</li> </ul>	<ul style="list-style-type: none"> <li>• Student dissertation published (<a href="#">Ref L</a>)</li> <li>• Multiple students won awards for meta-analysis dissertations (<a href="#">Refs C-F</a>)</li> </ul>
<p><b>Music lessons (2019-2020):</b> Face-to-face and remote piano lessons, practising daily using elements of the Suzuki method, mock grade exams. Suzuki recorder taster lesson.</p>	<ul style="list-style-type: none"> <li>• Daily practice got me from absolute beginner to Grade 4 in one year. How do I get my students practising bioscience daily?</li> <li>• I really wanted to see other students learning</li> <li>• I experienced an anxiety attack the first time I tried to play to my teacher on Zoom</li> </ul>	<ul style="list-style-type: none"> <li>• Co-developed the STAR method which we shared at conferences (<a href="#">Ref X</a>)</li> </ul>
<p><b>Being a Mandarin Chinese student at DMU’s Confucius Institute (2019-2021):</b></p>	<ul style="list-style-type: none"> <li>• Due to my Irlen syndrome, I couldn’t learn from didactic-lectures</li> </ul>	<ul style="list-style-type: none"> <li>• Blogged about the experience and shared with my students</li> </ul>

<p>Weekly face-to-face and remote lessons (group and 1:1), weekly homework, took three exams (HSK1, HSK2, HSKK)</p>	<ul style="list-style-type: none"> <li>• Flipped classroom was amazing</li> <li>• The lessons I enjoyed most were those that I co-created e.g. teacher asked me to create a game</li> <li>• Felt awkward being a mature student, tricky to make friends online</li> </ul>	<ul style="list-style-type: none"> <li>• Ran a <a href="#">national webinar</a> giving staff the opportunity to learning Chinese using a flipped classroom approach (pre-video with summary sheet &gt; active live remote class) with 60+ attendees and 100% satisfaction (Ref Y)</li> </ul>
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## 2.5 Putting this all together to build remote bioscience module with flip-flopped student-lecturer and lecturer-student input

Pre- and at the start of term, I worked closely with members of the module team who included Student Lecturers (Similoluwa Shobalolu, Hannah Bridge and Palak Gill), a Student Pedagogic Researcher (Furaiya Spibey) and my lecturer colleague Dr Shabana Cassambai; building in my reflections as a Lecturer-Student (**Figure 4**). Some of our co-created UDL approaches are shown in **Figure 5**.

	Student-lecturer view	Lecturer-student view	Co-created approach
Teaching	Students don't want to be lectured at – we want to practice. Use live sessions for knowledge checking. Students need more help but some may get bored.	I couldn't see properly so couldn't learn in live lectures. Flipped classroom was amazing for pre-class knowledge and in-class practice, especially when it was fun and I joined in.	Flipped classroom: pre-recorded lecture video with summary sheet, followed by live knowledge checking session. Drop-ins and competitions to sport and challenge.
Assessment	The assessment is currently too easy and doesn't prepare us for year 2. We don't know how to write a journal article. Students will need IT support. Give them an example and early mark scheme.	I did so many practice papers before my HSK2 exam but they only had model answers, there was no chance to spot mistakes... I didn't find a mark scheme for my HSKK exam and my grade was 30% lower.	Working with my colleague Dr Shabana Cassambai, we co-create a one-page journal article capstudy. Student lecturers co-created the unexemplar and rubric. Flipped feed-in, peer feedback and weekly tutorials.
Feed-in	Students need chance to practice skills, talk to each other and have fun. A remote escape-lab could provide engaging and fun practice.	I learned Mandarin best through playing games with others even though I'm happy learning alone. We'll need to prompt students to speak to each other online – I hated classes where nobody spoke.	Furaiya, my dissertation student, co-created a remote escape-the-lab game with the first years. They could work in groups, with help from "demonstrators", or do it alone.
Community	Making friends is so important, especially in first year, ideally with people whom they'll be in practicals with.	I really missed out on having a group of study buddies when I was learning 1:1. I found it hard to learn when others were not at my level.	Inspired by the STAR approach, I put students into cousin groups (~20) which were broken down into sibling groups (~5). Students could use the VLE or WhatsApp to meet up any time. Groups based on programme and tutor.

Figure 4. The process of blending our flip-flopped viewpoints to co-create our inclusive approach

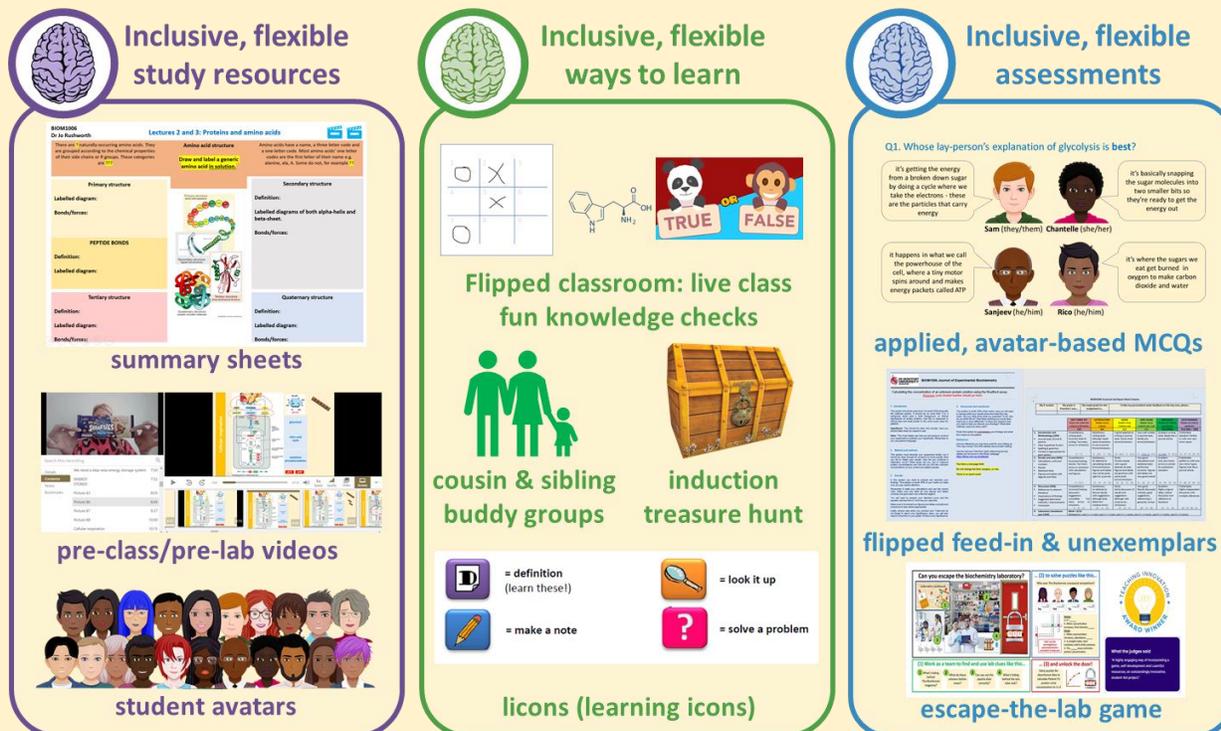


Figure 5. Co-created, inclusive, flexible approaches for decompartmentalizing the remote bioscience classroom

Student Pedagogic Researcher Furaiya’s award-winning formative escape-the-lab game was a great success; students enjoyed it and the activity increased students’ summative grades and confidence in an inclusive way (Figure 6).

The new journal article-style assessment was also greatly successful, with a high pass rate (97%) and students with an entitlement to learning adjustments out-performing their peers (Figure 7). The new open-book, applied MCQ test, which replaced the summer exam, was more challenging but we saw a higher pass rate and average mark compared with the previous academic year (2021: mean average 57%, pass rate 88% c.f. 2020: mean average 54%, pass rate 85%). Students were very happy with the module overall (Figure 8).

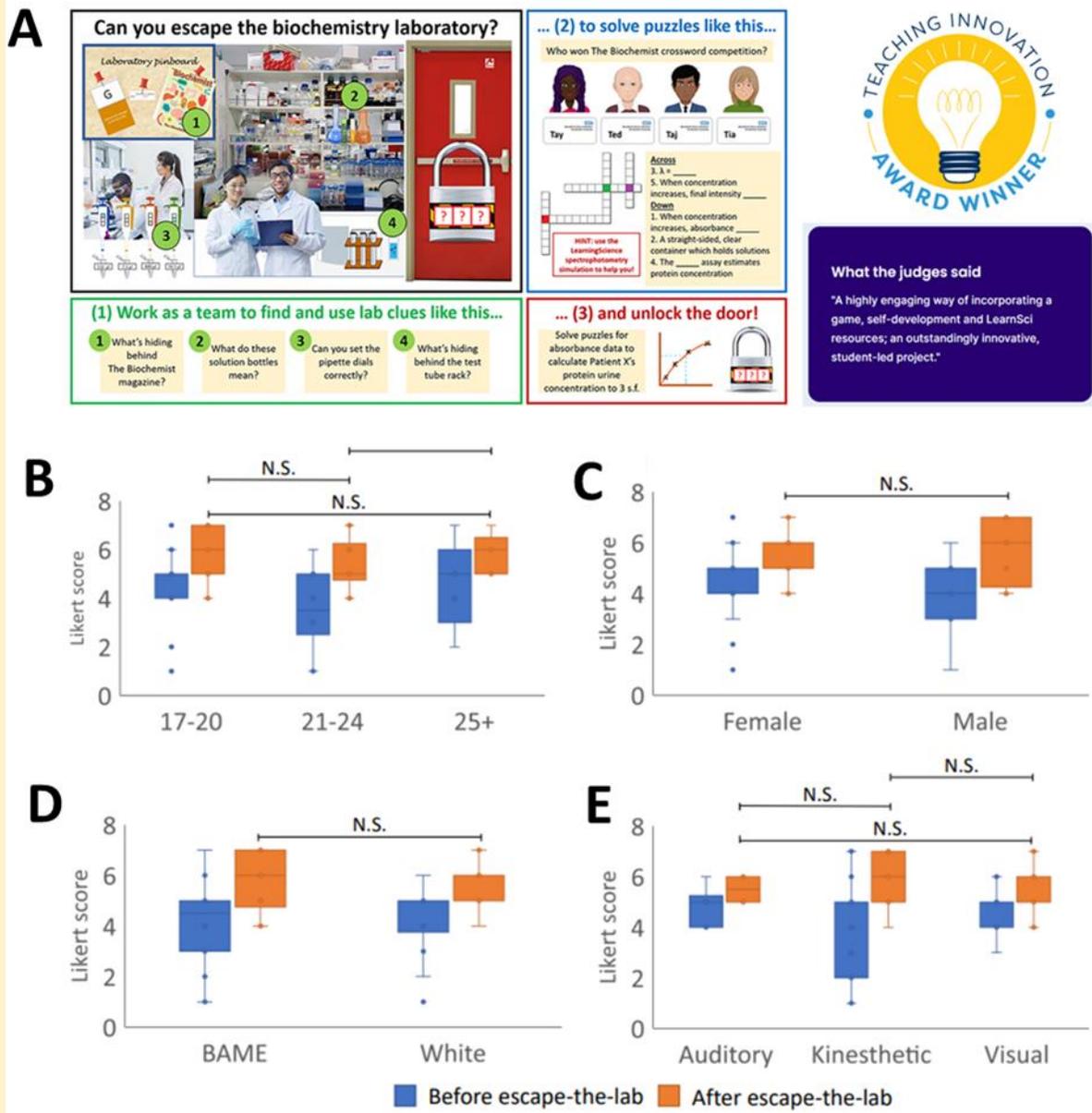
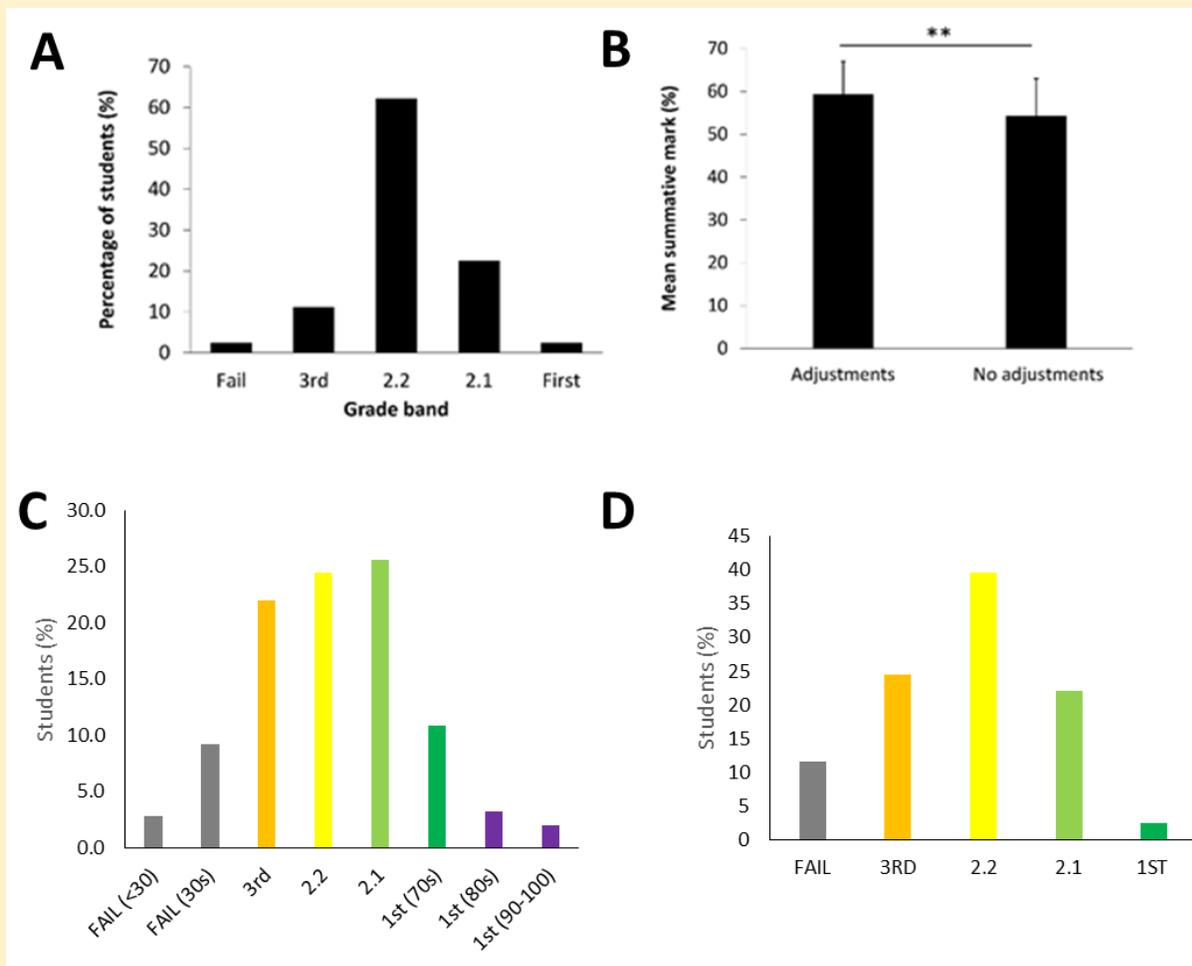


Figure 6. Furaiya's formative escape-the-lab activity increased students' overall confidence in doing their assessed practical with no significant difference between demographic groups.

(A) Furaiya's escape-the-lab activity won a LearnSci Teaching Innovation Award. Overall confidence pre- and post-escape-the-lab activity was found not to be statistically different between (B) age groups\*, (C) ethnicity\*, (D) gender groups\*, (E) learning style#. BAME - Black, Asian and Minority Ethnic. Responses on a Likert scale from 1 to 7. *(Figure adapted from Furaiya Spibey's dissertation; manuscript in progress).*



**Figure 7. Impact of inclusive co-creation on the Biochemistry and Cell Biology module**

**(CONFIDENTIAL – PANELS A AND B TAKEN FROM AN ACCEPTED MANUSCRIPT CURRENTLY UNDER REVIEW)**

**(A)** A normal distribution of summative assessment marks in the lab report was observed ( $n = 251$ , mean =  $55.6 \pm 7.3$ ); **(B)** The mean summative mark of students in the lab report with an entitlement to learning adjustments was significantly higher ( $n = 18$ , mean =  $59.3 \pm 7.6$ ) than students without ( $n = 233$ , mean =  $54.3 \pm 8.7$ ; Mann-Whitney U test;  $p=0.0071$ ); **(C)** Applied, open-book MCQ test results followed a normal distribution (Mean =  $54\% \pm 14$ , Pass rate = 88%, Range = 17-100,  $n = 250$ ); **(D)** Overall module marks (2021 mean =  $57\% \pm 10$ , pass rate = 88%).



## Dissemination references: evidence of co-created awards, conferences and publications

**Key:** 🏆 = award 🗨️ = conference presentation 📄 = publication **red text = undergraduate student**

- A** 🏆 LearnSci Teaching Innovation Award Winner (2021): **An inclusive smart worksheet.** **Allana, M., Bhatt, P.Y.,** Bremner, P.D., Valand, N., Ramos, I.R.M. and Rushworth, J.V.
- B** 🏆 LearnSci Teaching Innovation Award Winner (2020): **An escape-the-lab room.** **Spibey F,** Cassambai S and Rushworth JV.
- C** 🏆 **Pandya M** (Supervisor: JV Rushworth) **“Playing board games to counteract Alzheimer’s disease: a meta-analysis.”** Dean’s Dementia Dissertation Award Winner (Faculty of Health and Life Sciences, DMU), 2021
- D** 🏆 **Verma J** (Supervisor: JV Rushworth) **“Can the common spice saffron act as a preventative agent for Alzheimer’s disease: A meta-analysis.”** Dean’s Dementia Dissertation Award Winner (Faculty of Health and Life Sciences, DMU), 2020
- E** 🏆 **Loey N** (Supervisor: JV Rushworth) **“Beta-2 microglobulin as a potential biomarker for Alzheimer’s disease: a systematic review and meta-analysis.”** Dean’s Dementia Dissertation Award Winner (Faculty of Health and Life Sciences, DMU), 2019
- F** 🏆 **Kotecha AM** (Supervisor: JV Rushworth) **“Olfactory Dysfunction as a Biomarker for Alzheimer's Disease: A Meta-Analysis.”** Dean’s Dementia Dissertation Award Winner (Faculty of Health and Life Sciences, DMU), 2017
- G** 🗨️ **“Student lecturers are the future of Higher Education”** Rushworth JV, **de Gusmao Araujo P, Bridge H, Cornish R, Ganatra N, Gulati H, Patel M, Shobalaju S and Wan K.** Advance HE Teaching and Learning Conference 2021: Teaching in the spotlight: What is the future for HE curricula? July 7th 2021
- H** 🗨️ **“Summary Sheets: a scaffold for more effective, active note-taking and cognitive processing of (remote) lectures.”** Rushworth JV, **Cornish R, Gulati H and Patel M.** Horizons in STEM Higher Education Conference. June 29<sup>th</sup> 2021.
- I** 🗨️ **“Creating student-centric, flipped assessment and feed-in for a remote future.”** Rushworth JV, **Spibey F** and Cassambai S. HUBS and HUCBMS Joint Workshop: Co-creating assessments for the remote world. June 4th 2021.
- J** 🗨️ **“Student lecturers are the future: Come and meet us to find out why!”** **de Gusmao Araujo P, Bridge H, Cornish R, Gulati H, Kumaraguru V, Patel M, Shobalaju S, Wan K** and Rushworth JV. DMU’s Learning and Teaching Conference “The University of Tomorrow”, February 5<sup>th</sup> 2021.
- K** 🗨️ **“Gamification of cell biology using the PlayStation game Little Big Planet”** **Charlesworth S** and Rushworth JV. Interactive workshop, Playful Learning Conference, July 10th 2019. Press release [here](#).

**L**  Olfactory Dysfunction as a Global Biomarker for Sniffing out Alzheimer's Disease: A Meta-Analysis.  
**Kotecha AM, Correa ADC, Fisher K, Rushworth JV (2018) Biosensors. 13:8(2)**

**M**  (manuscript accepted subject to revisions, Feb 2022) **"Co-creating a flipped feed-in approach to virtual biochemistry lab assessment: increasing student achievement and engagement in a large, diverse cohort"** Cassambai S, **Bridge H, Gill P, Shobaloju S**, Sgamma T, and Rushworth JV. *Essays in Biochemistry*.

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3. <https://udlguidelines.cast.org/>
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