

Innovate to educate: using science communication to enhance learning and engage learners.

“Emma is a truly exceptional teacher; she produces innovative and engaging content which keeps students enthused and entertained throughout... She receives consistent positive feedback from students... Emma has achieved far more in a few short years than many colleagues would hope to achieve in an entire career, she is on a very steep trajectory to being a truly international voice in education.”



- *Cardiff University Celebrating Excellence Awards Nomination 2021.*

1. Background

As an educator, I am passionate about content delivery. Lectures can be delivered in engaging ways to inspire and enable students to learn more effectively. My case study describes the benefits that more creative teaching approaches, embedded in science communication, can bring to the academic and pastoral student experience. My teaching philosophy is driven by my desire to make teaching inclusive, allowing bioscience students to recognise the relevance and value of the skills and knowledge that they gain in Higher Education.

I believe that exemplary engagement, communication, and connection are at the heart of excellent teaching; by making learning more accessible, inclusive, and fun, everyone benefits. My case study focuses on the ways that I have creatively transformed first year undergraduate lectures.

2. Reasons for introducing this teaching method

I began my lectureship in September 2019 and was struck by how many students expected their lectures to be boring and uninspiring, they felt lectures were to be endured rather than enjoyed. I was determined to apply my expertise in science communication to make lectures inspiring and engaging for students.

The traditional didactic lecture format is known to be ineffective as an educational approach (Schmidt *et al.*, 2015), although lectures are still commonly used in Higher Education. I believe that lectures can be entertaining whilst still enabling students to learn effectively. Students also want to know more about the real-world implications of the content they are learning. Given that only 20% of biology graduates will go on to a scientific occupation (What do graduates do? 2021/2022), I incorporate real examples, case studies and lived experiences into my teaching to make the content relevant.

3. Lecturer's perspective

Cardiff is a Russell Group university, where the emphasis on research excellence alongside teaching excellence can create tensions. After moving from a research-only contract to a teaching-and-scholarship role, I wanted to raise the profile and recognition of teaching excellence within my university and among academic colleagues more widely, to create exceptional learning opportunities for students.

Lecturing large cohorts of 500 students, I introduced live demonstrations, props, interactive polling, music, and videos into my lectures. During the COVID-19 pandemic, I trialled new methods to engage students online (Figure 1A-D). I have also incorporated other innovative demonstrations including vision changing goggles, interactive spot the difference challenges and at home experiments.



Figure 1 - Creative and engaging approaches to online teaching.

A. A demonstration of neurotransmission including a light up cuddly neuron and a bubble gun. **B.** A draw along live highlighting the knee jerk reflex. **C.** A live demonstration of the direct pupillary response to light.

D. An at home gummy bear experiment to demonstrate osmosis and diffusion across semi-permeable membranes.

Innovative teaching approaches evidenced with student feedback include:

- **Well-being polls.**

Anonymous polls at the beginning of lectures to ask students how they are. This creates a welcoming environment and provides an opportunity to signpost to support services.

*"I love the wellbeing polls. The lecturer **understands and cares** about us. I appreciate that you ask us how we are...this was especially useful when I was feeling low...you reminded me that **people do care.**" – Year-1 student*

- **"Mini-discos"**

Pedagogical evidence shows that music enhances learning (Dosseville et al., 2012); I introduced "mini-discos" which created a welcoming learning environment and improved student wellbeing.

*"The mini-discos were **awesome**...I read up on what was coming...they **cheered me up** and made me **look forward to the lectures.**" – Year-1 student.*

- **"Draw-along" live**

Reflex responses are a topic which students have previously found challenging; I introduced "draw-alongs" (Figure 1B) to illustrate content in an accessible way, this also served as a useful revision aid. The draw-along improved understanding and knowledge acquisition in module exams (Figure 2- Q3).

*"The draw-along was **excellent**...I liked that you took time to go over it slowly to **help us understand.**" – Year-1 student.*

4. Students' perspective

Students often struggle in transitioning to university and can feel isolated and lonely, particularly during the pandemic (Groarke et al., 2020). In designing engaging lectures, I have created more inclusive and welcoming environments which positively impacted learners academically (Figure 2) and pastorally (Figure 3).

*"You spoke to us like we were people, I **feel welcome** and like that you include your **gender pronouns** during lectures." Year-1 student.*

*"The lecturer checks up on how students are **feeling** which I really appreciate...The lecturer is very **positive** and **approachable** and makes the lectures so much more **enjoyable.**" - Year-1 student*

*"The **most engaging** lectures that I have had **EVER.**" – Year-1 student.*

My engaging teaching approaches have increased student performance in module exams. The success rate on the exam questions for my teaching improved for every question (Figure 2) and the overall the success rate rose from 67% to 78%. My teaching approach is viewed extremely positively by students. In 2020/21 anonymous feedback, 79% of students rated my overall lectures as "Excellent" and 99% rated them as either "Excellent" or "Very Good" (Table 1). Additional free text comments provide qualitative evidence of the main reasons that students consistently rate my teaching as excellent (Figure 3).

Student success rate on multiple choice exam questions

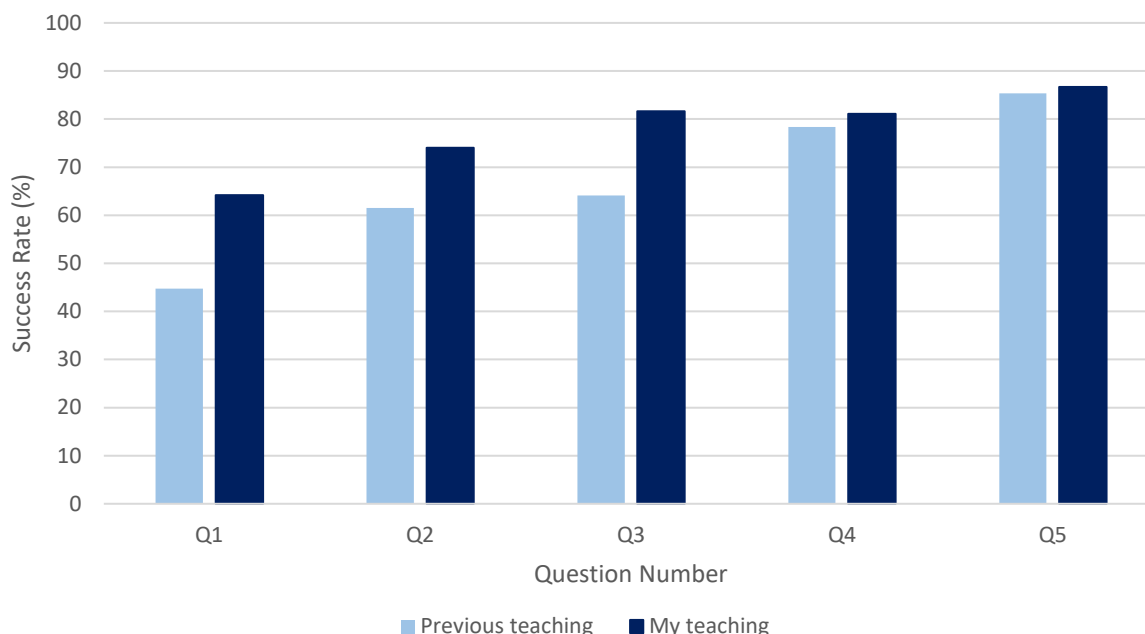


Figure 2 - Student success rate in end of module exam multiple choice questions (MCQs).

Graph to show average student success rate comparing previous teaching (shown in blue) to my teaching (shown in orange). Student success rate improved on every question and overall, by 11% across all questions. n=329 in previous teaching and n = 429 in my teaching.

Table 1 - Teaching Module Evaluation Scores for 2020 / 2021.

All teaching module evaluation scores were obtained from anonymous feedback forms sent to students. Students were asked to respond to questions based on a Likert scale of; 5 = Excellent/ Strongly Agree, 4 = Very Good / Agree, 3 = Good / Neutral, 2 = Poor / Disagree, 1 = Very Poor/ Strongly Disagree. Data is given for responses of "Excellent" and "Very Good". Summary data is given from 231 anonymous responses from Year 1 students.

	Question Asked			
	How would you rate the lecturer overall?	The lecturer was enthusiastic about the topic area	The lecturer explained important concepts and ideas in ways that I could understand.	I found that the lectures contained interesting and relevant information.
Percentage of students rated "Excellent" 2020/ 2021 (All Modules)	79%	90%	77%	75%
Percentage of students rated "Excellent" or "Very Good" 2020/ 2021 (All Modules)	99%	100%	93%	92%



Figure 3 – Word cloud generated from free text student comments on Year 1 undergraduate lectures.

The word cloud is based on 231 responses anonymously collected from students across two Year 1 modules within the School of Biosciences. Word sizes reflect the regularity of words within free text comments. Words given less than 15 times are excluded.

5. Innovation

My innovative approaches are driven by my ability to apply my skills in science communication, and to think creatively about teaching. Higher Education can contain unhelpful power dynamics and hierarchical structures which create barriers to learning (Thomas, 2001); I believe in authentic teaching and including personal examples to inspire students and provide role models. I have included my family history of Alzheimer’s disease or videos of my cats to demonstrate the neural control of stepping, to show students that the content that they are learning has real-world implications and is delivered by a genuine, real and passionate person.

6. Inclusion

As a female first-generation early career academic from a working-class background, I have direct experience of the barriers and challenges to participating in Higher Education. I create inclusive and accessible content, including my gender pronouns online and giving warnings prior to playing any sound effects. When designing at home experiments, I suggest items which students will typically have at home to minimise socioeconomic barriers. Through my work with the British Neuroscience Association, I have created the Scholar’s Scheme to improve diversity and representation in Neuroscience and collaboratively we have created resources to decolonise teaching.

7. Challenges

There is a concern that fun and engaging teaching trivialises education. In this case study I successfully demonstrate, using qualitative and quantitative evidence, that it is possible to create engaging lectures which not only enable students to learn effectively, but are beneficial to their learning and wellbeing (Figures 1-3 and illustrative quotes).

8. Wider influence

In creating innovative teaching, I have been contacted by educators outside of my institution who wish to explore my teaching approach further. I have provided careers talks and training and shared my teaching approaches with educators and external partners across the United Kingdom. I have mentored and supported others in evaluating their approaches and many have changed their own teaching practice as a direct result.

*"I was **inspired** by Emma's "draw along" lectures to **create my own versions**, which students have consistently said has **changed their understanding** of the topic"*

– Dr Simon Cork, Senior lecturer in Physiology, Anglia Ruskin University School of Medicine.

*"Emma has shown me that I can **think differently about the ways that I engage** with students to be **more creative and engaging** in how I teach."*

- Dr Scott Morgan, Digital Lead Bridgend College (leading college provider of HE in Wales).

*" Emma delivers impactful and high-quality Bioscience education **beyond Higher Education to diverse audiences**...she creates an experience which is **truly equitable**, this makes her **stand out** as a person, a professional scientist and an educator."*

- Sian Ashton, See Science STEM Ambassador Coordinator for Wales.

Working collaboratively with GOWales I have provided work experience opportunities for students from disadvantaged backgrounds. I have supported many students to pursue careers both within and outside of academia. Based on my teaching approach, several studies were inspired to pursue this field and they now have careers in science communication.

9. Final reflections

In transitioning to a teaching-and-scholarship contract, I was shocked at how many people questioned whether I was "sure I wanted to move into teaching" or commented that I was no longer "a true researcher." Having conducted pedagogic as well as science communication research (see Publications), I want to demonstrate that educational research is just as valuable to students, the university and wider society as "traditional research".

Engaging teaching approaches are often trivialised or written off, this provides additional motivation for me to demonstrate their relevance and efficacy given the significant time, resource, and effort that this approach requires. In creating unique teaching content which stands out, I want to inspire and help colleagues to see the benefits of this approach and join me in creating more enjoyable, creative and welcoming teaching and learning experiences for our students.

Word count: 1492 (excluding Figure legends, publications and references).

10. Publications

In addition to my publications in neuroscience research (available at: <https://www.cardiff.ac.uk/people/view/225350-yhnell-emma>) I have recently focused on publishing work in pedagogy and science communication.

Publications in engagement and outreach

Morgan, S., Randle, A., Coombs, R. and Yhnell, E., 2020. Giant genes! The development of an interactive game to engage audiences in genetics. *Journal of Stem Outreach*, 3(1). DOI: 10.15695/jstem/v3i1.14.

Yhnell, E. 2020. How the brain works. How it works. DK. – Popular Science Book

Yhnell, E., Andrade-Sienz, A. and Knight, J. 2020. “Snap anatomy”: the development of a game to engage audiences in anatomy. Presented at: 19th Congress of The International Federation of Associations of Anatomists (IFAA 2019),

Yhnell, E., Smith, H.A., Walker, K. and Whitehouse, C., 2019. # WhyWeDoResearch: Raising research awareness and opportunities for patients, public and staff through Twitter. *Research for All*. Vol. 3(1):7-17. DOI: 10.18546/RFA.03.1.02

Publications in pedagogy

Yhnell, E. et al. 2016. The impact of attaining the Welsh Baccalaureate Advanced Diploma on academic performance in bioscience higher education. *International Journal of Science Education* 38(1), pp. 156-169. (10.1080/09500693.2015.1135353)

Smith, P. et al. 2016. The 'Sophomore Slump' - do learners recover and can year-on-year grade begin to provide answers to difficult questions?. Presented at: British Educational Research Association Annual Conference, Leeds, UK, 13-15 Sept 2016.

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Thomas, L., 2001. Power, assumptions and prescriptions: a critique of widening participation policy-making. *Higher Education Policy*, 14(4), pp.361-376.

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