

# *In a world of wicked problems, we must straddle disciplines for answers*

Interdisciplinary teaching in universities needs to be encouraged. But first, we must break down some barriers.

**Andy Tay**

My research involves developing immune cells to fight cancer. Although I secretly hope that none of my family members and friends would ever need to benefit from my work, I know that this is self-deceiving because the statistics are unforgiving: One in every five Singaporeans will get cancer over their lifetime.

The mother of my best friend recently was diagnosed with metastatic cancer and, as a form of support, I started reading about the state of immune cell cancer therapy in Singapore should she need it. I was shocked to learn that patients can wait up to two years to get their treatment due to a global manufacturing shortage. There is also no public or private subsidy for this treatment in Singapore which costs about \$670,000. This means that access to this advanced therapy is currently limited to affluent patients.

This reality hit me hard because while I understood that

developing a new medical therapy takes time, witnessing first-hand how cancer patients are denied that option due to manufacturing shortage and a lack of payment coverage made me feel that there must be more I can do beyond scientific research.

In other words, to truly help the patient, one would need to bring together different disciplines, including biology, technology and finance.

Therefore, in the semester that has just ended, I took up an opportunity to create and teach two interdisciplinary Stem (science, technology, engineering and mathematics) courses at the National University of Singapore's (NUS) Department of Biomedical Engineering and NUS College, focusing on the use of immune cell therapy for cancer.

## **EMBRACING DIFFERENT DISCIPLINES**

As the case that I mentioned shows, solving a problem sometimes requires bringing together concepts, perspectives and techniques across disciplines. This is where interdisciplinary education comes in. So, to make immune cell cancer therapy more accessible, we need a better scientific understanding of cancer immunology to engineer immune cells that can be supported by existing manufacturing protocols.

We also need innovative payment models so that we do not deny treatments to patients who need them the most.

Schools are vital in training interdisciplinary educators and students. NUS has made advances in this regard by creating a comprehensive general education curriculum for all undergraduates to read interdisciplinary modules in areas such as data literacy and community engagement, and establishing colleges such as the College of Design and Engineering, College of Humanities and Sciences and NUS College where students pursue a common curriculum comprising interdisciplinary modules.

A survey by Times Higher Education found that Singapore is ranked as one of the best places for interdisciplinary education and research, but this has yet to gain traction globally.

Yet, if we stand a chance to overcome wicked problems such as the rising prevalence of chronic diseases and rapid climate change that are fraught with loosely defined boundaries and contested causes and solutions as a society, we need a switch from the traditionally singular discipline-focused model of learning to one which is interdisciplinary. This is because real-world problems are multi-dimensional and defy

categorisation.

One hurdle is that many Stem teaching staff find it daunting to teach interdisciplinary classes. In my own learning journey as an educator, I discovered three factors that might discourage Stem educators from embracing interdisciplinarity, and there are ways to overcome them. Although my ideas are primarily based on university education where I have the most experience, they could still be relevant to tertiary and even earlier stages of education.

## **CHANGING MINDSETS**

Studies have found that educators who are trained in a single discipline are motivated to protect their disciplinary turfs. Likewise, some professional bodies such as degree accreditation boards may resist interdisciplinarity on the grounds of lack of depth.

They are not wrong. For interdisciplinarity to work, students need to first have basic foundations of a particular discipline. We should also appreciate that not all courses must be interdisciplinary and not every educator is keen to embrace interdisciplinarity.

However, a responsible educator would be aware of the value of interdisciplinarity, especially when employers increasingly value students educated under such a pedagogy for their problem-solving abilities.

While changing entrenched mindsets is not easy, incentives such as teaching grants, travel fellowships to attend education conferences, and establishing interdisciplinary teaching awards can help. But for a more permanent solution, we need a mindset change.

It is no secret that the majority of university professors who are on the tenure track system, like me, are hired for our research track record. If we can show that teaching interdisciplinary classes could benefit research, we can encourage more colleagues to embark on this journey.

Over the past semester, as part of the interdisciplinary courses I was teaching, my students and I visited biotech companies and interacted with guest speakers from the industry. These interactions helped me appreciate the value of sending my research trainees for industrial internships,

where they can gain knowledge to design projects with potential for scaling up and research translation.

A PhD student of mine just completed an internship at a biotech investment company where he learnt to evaluate the potential of technologies for commercialisation and communicate to investors. This stint trained him to apply methods in business to evaluate science, create an effective pitch deck to attract industry-relevant funding for my lab. I am certain academic research alone cannot provide this level of education.

## **BREAKING DOWN STRUCTURAL BARRIERS**

Educators at universities need to fulfil required teaching hours at their home departments. When two academics from different departments wish to co-create an interdisciplinary class, their respective departments will need to negotiate the "buying" of teaching hours. Sometimes, in avoiding this administrative hassle, teaching collaborations between educators take the form of guest lectures, which might not be ideal for interdisciplinarity.

A centralised unit that can buy teaching hours and channel educators to different departments based on their needs may be useful. Universities can also consider hiring a centralised pool of interdisciplinary educators who will help to identify key areas where interdisciplinary education is essential but lacking, and create workable teaching models to fill this gap. These educators can also be seconded to work with professors in various departments to co-create and co-teach interdisciplinary courses.

When I started teaching, I was worried whether the first few weeks of classes on the engineering side of cell manufacturing would scare away students from non-Stem backgrounds and disappoint Stem students hoping to go deeper into the topic. To prepare myself, I sought advice from more experienced colleagues and reviewed other interdisciplinary Stem courses.

Removing structural barriers and having a dedicated pool of

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## *Building confidence to teach across disciplines*

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interdisciplinary educator colleagues to consult would have made my learning process smoother. That might have allowed me to retain two non-Stem students who e-mailed me, explaining why they had decided to drop the class.

### START SMALL AND SCALE UP

Most university educators are not formally trained in interdisciplinary teaching. When I shared with my colleagues that I started teaching interdisciplinary classes, many were concerned if this might increase my workload and whether I had the credentials. Their questions were valid.

As an example, I had a writing assignment where my students needed to communicate the risks of a new gene delivery method for a child enrolled in a leukaemia clinical trial. This essay requires students to apply concepts in quantitative reasoning to evaluate the statistical soundness of the literature, principles of immunology to critique the limitations of the experiments, and, finally, skills in science writing to communicate to the young patient.

While I do not have a degree in science writing, I made up for it by writing articles for science media companies including Springer Nature for the last seven years. My writing experiences beyond my research speciality have prepared me to assess how superhero stories written by my students can make a difference to a child's understanding of cancer immunotherapy. We need such additional experiences to create and assess interdisciplinary materials.

To gradually build the confidence and capability of educators to teach interdisciplinary courses, universities can consider the concept of mini-classes for educators to start small and scale up progressively. For example, educators from at least two distinct disciplines must team up to repackage and integrate teaching materials from their existing courses into mini-classes. Multiple mini-classes can be showcased during an "interdisciplinary module week" to prospective students and employers. Based on feedback, some mini-classes can evolve into half or full interdisciplinary courses.

When I was a PhD student, there was no limit to the number of courses I could attend, and I remember going from a class in philosophy to business and bioengineering. Although these courses were not designed to be interdisciplinary, they had already enabled me to see the complexities of real-world problems.

When educators can be given guidance to integrate content across disciplines, students can benefit even more by developing skills to identify and overcome wicked problems through an interdisciplinary approach.

There is an extensive body of literature theorising the definitions of interdisciplinary education. It is time we put these theories into practice. Top universities worldwide are doing this. Stanford University lists an impressive 40 interdisciplinary degree programmes on its website. The recently launched NUS College has a common interdisciplinary curriculum for students from different disciplines.

I hope to see more of my Stem colleagues joining me to create and teach interdisciplinary courses. I can assure my colleagues that the journey will be worthwhile.

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