Embedding Sustainability In Mathematics? You must be joking!!! Ms. Malmi Mahagamage, Ms. Meherun Soud and Dr. Rehan Shah

1. OVERVIEW

For the last two decades, there has been a growing demand to incorporate sustainability within HE teaching. However, universities have found it **challenging to integrate sustainability** in disciplines such as mathematics.

This project showcases the **co-creation of sustainability toolkit** resources by two undergraduate students, designed to integrate sustainability within mathematics modules. The toolkit features posters that demonstrate the importance of sustainability, brief history and present a variety of mathematical problems, aligned to the Sustainable Development Goals (SDGs). These resources aim to help students to understand the role of sustainability in mathematics by **fostering their critical thinking** and problem-solving skills.







2. BACKGROUND

The UN SDGs were introduced in 2015. Since then, universities have struggled to integrate sustainability into mathematics, as it is seen as a theoretical subject and disconnected from real-world applications.

must change. Embedding sustainability into This mathematics can help us address global challenges by bringing abstract concepts into contact with practical issues.

3. METHODS AND APPROACH

- Co-creation (staff-student partnership) of teaching toolkit resources.
- Interviewing into existing course material.
- Integrating in a seamless and organic matter.
- Links with the UN Sustainable Development Goals.
- Subjective and reflective aspects.
- Piloted in a first-year undergraduate applied mathematics module.
- Delivered asynchronously.



Context of the problem: In a particular admissions cycle, a mathematics department observes a higher success rate for male applicants than for female applicants. To investigate whether this is the same across the two sub-departments of Pure and Applied Mathematics, the following year the department asks each applicant to give their preference for pure or applied mathematics (they are not allowed to be ambivalent) and records the resulting statistics as shown:

Total:								
			Applications		Successful			
Pre	Female Male		300 1000		30 210 Prefer		, pure	
App	Applications St		ccessful	1		Applications		Successful
Female Male	270 350		18 15	Female Male		30 650		$12 \\ 195$

- prefer pure mathematics and their success rates overall.

Mathematical approach: This problem focuses on applying probability and data analysis to demonstrate Simpson's paradox, a statistical phenomena in which a trend appears in several groups of data but disappears or reverses when the groups are combined. The question involves calculating and comparing the success rates for male and female applicants within each of the subgroups, which are Pure Mathematics and Applied mathematics, as well as for the whole group. By examining how group sizes and success rates contribute to combined data, the analysis provide a deeper understanding of the mechanics of the paradox.

Key sustainability insight: This question combines mathematics with real-world issues related to gender equality (SDG 5) in education and professional environments.

- mathematics and other STEM fields worldwide.
- aligning with SDG 10.

This issue demonstrates the crucial role of mathematics in undercovering hidden disparities and supporting informed decision-making to promote fairness and equity.



Explore the 'Making Diversity Count' research project that links to SDG 5 and SDG 10.

SCHOOL OF ENGINEERING AND MATERIALS SCIENCE

School of Engineering and Materials Science

Examples of mathematical problems with embedded sustainability

Contribution to SDGs : Gender Equality (SDG 5), Reduced Inequalities (SDG 10)

Compare the success rates for male and female applicants that prefer applied mathematics.

What do you notice? Why is this possible? This is known as Simpson's paradox.

Gender disparities in STEM: This question draws attention to gender disparities in

Broader inequalities: It highlights how misinterpreting data can reinforce existing inequalities and shows the importance of transparency and accountability in data analysis,

Discover biographical posters of STEM Champions who challenged stereotypes and inspire the next generation!



5. RESULTS AND KEY FINDINGS

- Most students were unaware of 'sustainability in mathematics' prior to engaging with exercises, highlighting a gap in education on this topic.
- Students found the **integration of sustainability and mathematics engaging**, especially through real-world scenarios such as SDG goals.
- Visual aids like diagrams, videos, and additional links were recommended to enhance understanding and promote independent learning.
- While many students supported introducing these exercises in lectures or tutorials, some preferred keeping them optional to manage workload.

6. STUDENT FEEDBACK

- understand the mathematics behind optimising designs."
- encourages students to consider the broader implications of their work."
- even a society that runs sustainability related events."

7. CONCLUSION

Our project integrates sustainability into mathematical problem-solving, highlighting its societal relevance and fostering critical thinking. It supports academics in integrating sustainability into STEM courses, enhancing student engagement and helping students develop the necessary skills to address global challenges responsibly.



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Absolutely

Mostly Yes

Neutral

Mostly Disagree

Strongly Disagree

4. MODULE SURVEY (77 responses)

Did these resources make you want to learn more about sustainability in mathematics and its realworld impact?

• "I was familiar with sustainability in engineering but not in mathematics. Every time I hear about sustainability, I tend to focus on the design aspects. These resources helped me

• "I found it interesting how seamlessly sustainability is incorporated into the maths curriculum, making it seam natural and relevant. I also liked how the reflective aspect

• "It would be nice to have an **optional in-person session** for those interested in more, maybe





Scan QR codes for QMUL and **Cambridge University Sustainability** in Mathematics Resources