An enterprising approach to postgraduate engineering courses for sustainable futures.

IYALLA, I., MOULE, C., CHARLES, S. and MAHON, R.

2024

An Enterprising Approach to Postgraduate Engineering Courses for Sustainable Futures

Dr Ibiye Iyalla
SoE

Chris Moule
EIG

Sally Charles
UoO (EIG)

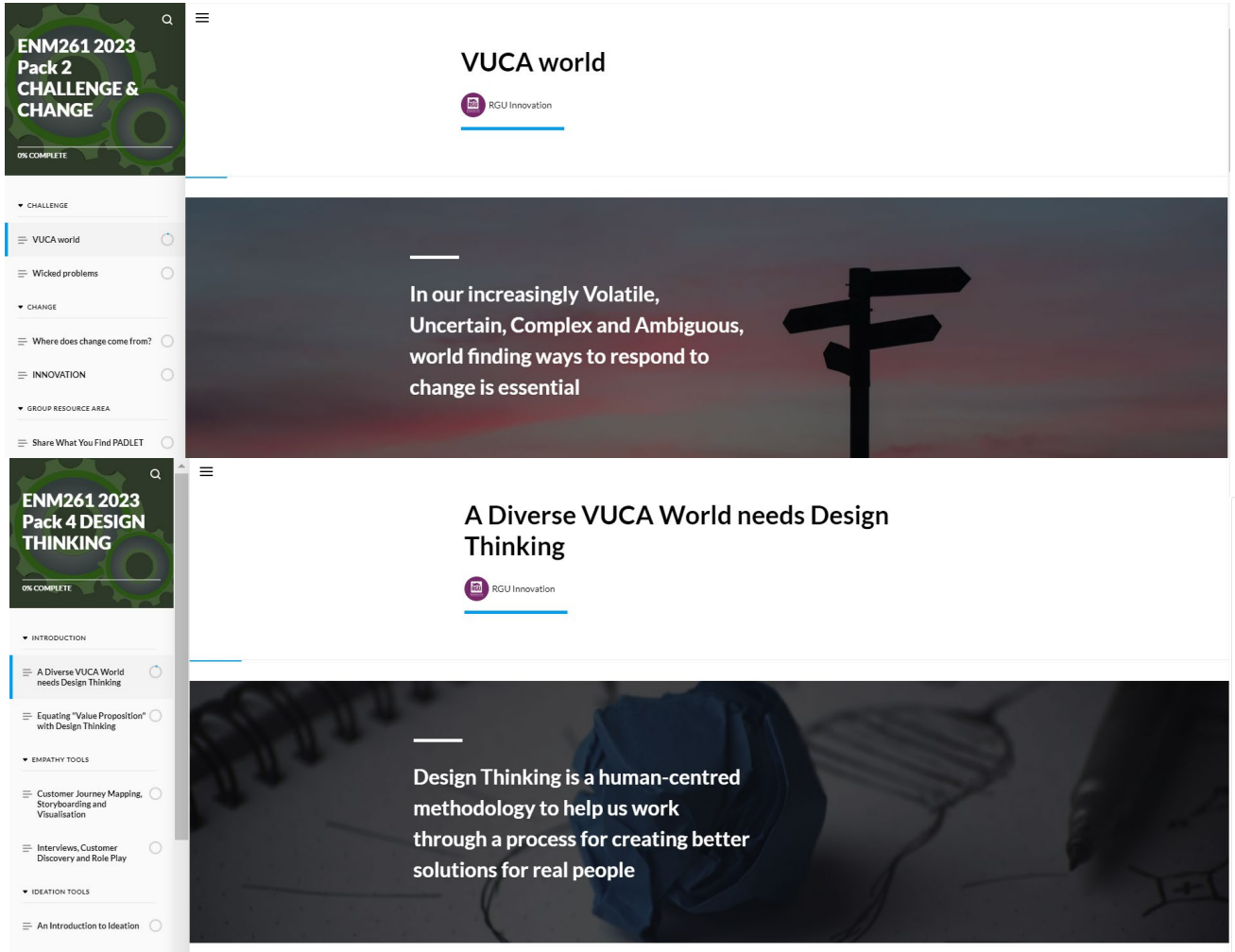
Dr Ruissein Mahon
SoE

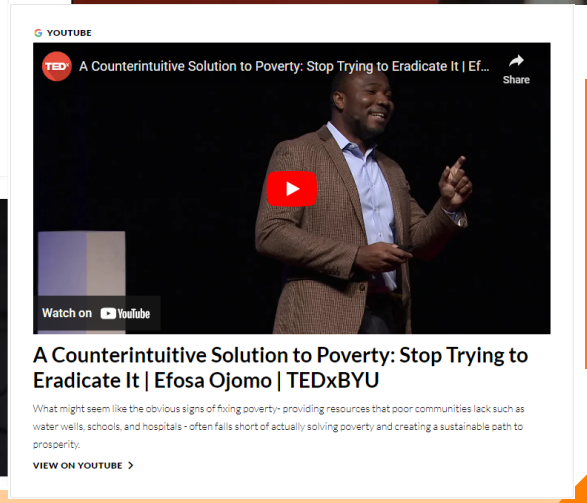
Postgraduate Module: Innovation and Sustainability

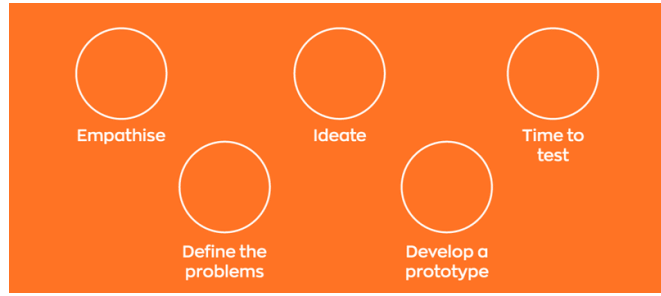
- **Module aim:** Provide students with experience of working as part of a **team** on a group project focused on identifying **innovations** to meet diverse societal needs aligned to one or more **UNSDGs**.
- **Postgraduate (MSc) engineering students**: Oil & Gas Engineering, Drilling & Well, Engineering Management; Renewable Energy Engineering.
- **Interactive sessions:** Bootcamp, Challenge & Change, UNSDGs, Design Thinking, Presentation Skills, and Reflective Writing.
- **Feedback loop:** Group discussions, Online forum, Padlet, Formative assessment, and Student Voice Module Feedback.

Learning Outcomes	AHEP 4
LO1: Evaluate the complexity of the selected UNSDGs to achieve target ambition. **LO2:** Synthesise the concepts and approaches for innovation thinking for sustainability. **LO3:** Generate a range of ideas that address issues from different perspectives using appropriate methodologies.	**M3:** Engineering Analysis **M5:** Design and Innovation **M7:** The Engineer and Society **M17:** Engineering Practice

Articulate Rise: Module Content

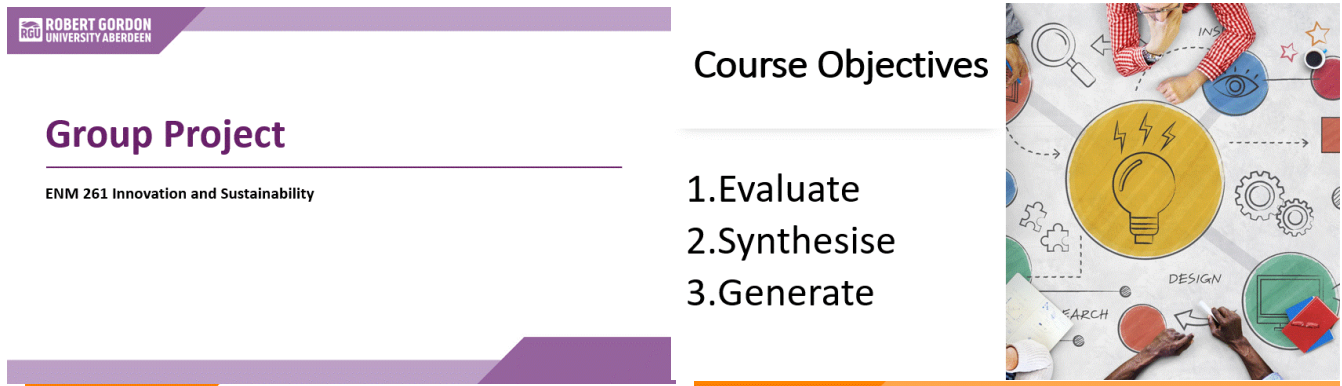


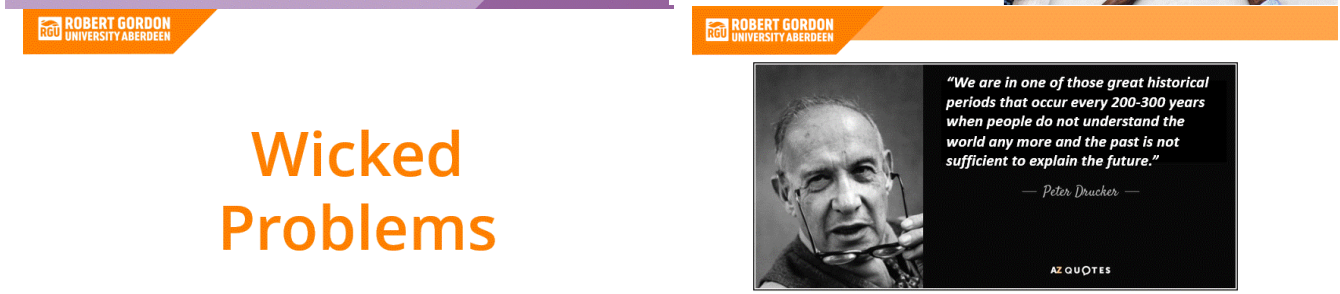




Bootcamp

- VUCA
- Wicked Problems
- UNSDGs
- Successful High Performing Teams
- Teaching/Learning Philosophy
- POD Colours
- Course Objectives & Expectations

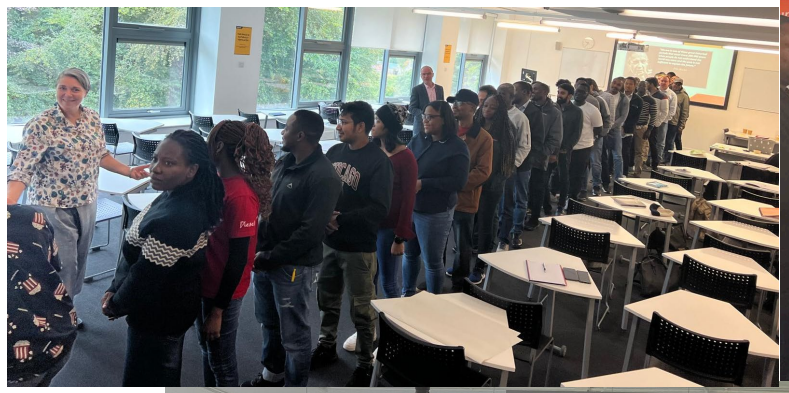




ROBERT GORDON UNIVERSITY ABERDEEN

Advance HE Teaching and Learning Conference

Bootcamp



Future-Focused Education: Innovation, Inclusion, and Impact

3rd July 2024

Challenge & Change

- VUCA
- Wicked Problems
- PESTLE
- Change
- Types of Innovation

DISCUSSION GROUP QUESTION:

How are the four elements of VUCA affecting water security?

DISCUSSION GROUP QUESTION:

Why is Health a wicked problem? Identify 2 or 3 engineering based solutions.

DISCUSSION GROUP QUESTION:

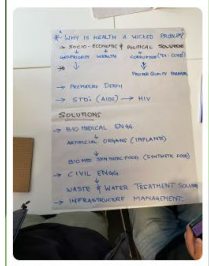
How can technological innovation improve food security?

DISCUSSION GROUP QUESTION:

What elements of P-E-S-T-L-E affect inequality and how?

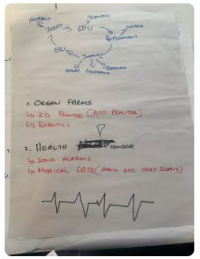
Padlet: Challenge & Change

Health a wicked Problem



Sujith

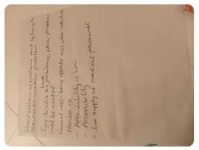
Wicked Problems & Health Care



Wicked problems are hard to solve due to their social complexity
Health is a wicked problem because of the interconnected factors that affect health and well being. Such factors can also be wicked problems themselves making things even more complex

Engineering Solutions proposed:
1 An organ farm to 3-D print necessary organs for transplanting. This is due to the fact that may people don't have access to organs necessary to solve health challenges many hospitals have huge lists of people waiting for a donor for kidney

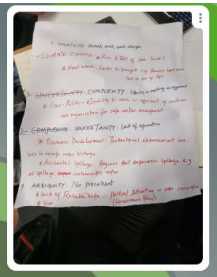
Why is health a wicked problem?

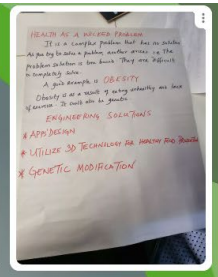


Names:
Hillary
Kwamena
Mohammad
Daniel
Jebarson

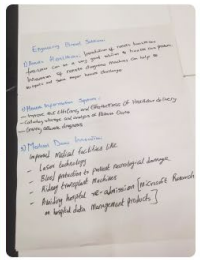
Health is a topic that is of paramount importance. The lack of well-being of a person can ripple into their inability to perform in other aspects of their lives, which could affect them as well as other people, and the society at large.
Also, it is worth noting that trying to solve a number of health issues give rise to the creation of new problems.

Engineering solutions to healthcare
1. Electrical Medical Devices, eg. Artificial cardiac pacemaker, blood-glucose meter, etc.: These medical devices have been developed to





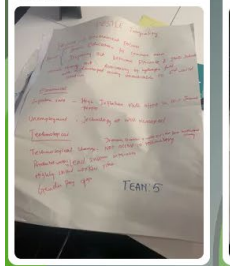
Health Wicked Problems



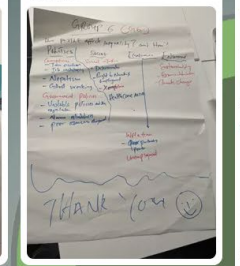
Health as a wicked problem. Health is not a problem, rather a state of good wellbeing. The famous saying 'health is wealth' underscores the importance of healthcare in our daily lives. We can practically do nothing without health, and this adversely affects our productivity. Moreover, the challenges of health are never completely solved.
In this piece, we try to highlight some engineering-based solutions to help address the global health challenges we currently face.

1. Remote Healthcare Facilities: Introduction of remote healthcare facilities will be a good solution to healthcare

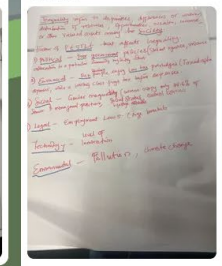
Group 5



Group 6

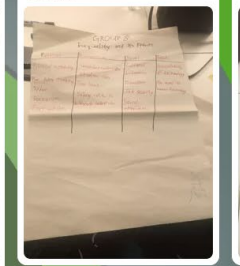


Group 7

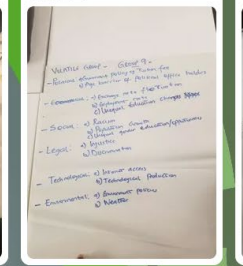


Group 7:
Other Elements under Economical include **exchange rates** which can influence investments and capital flows negatively and positively

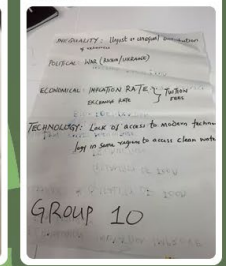
Group 8



GROUP 9



Group 10



Discussion 1

Water security is the capacity to produce enough water of sufficient quality for survival and to carry out different productive activities.

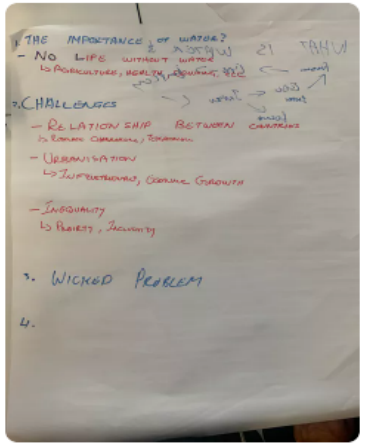
VOLATILITY: We live in an unstable world where there is constant changes.
Climate change: directly affects the sea level, it also affects the aquatic life. Also disasters like extreme heat affects the availability of water to certain regions for example the resent heat wave in Hawaii.

UNCERTAINITY: Lack of adequate information.
Economic Development: Technological advancement could lead to unsafe discharge that affects water.
Spillage: It affects water in regions with contaminated water feel the effect.

COMPLEXITY:
GEO POLITICS: Inability to reach an agreement by countries and organization in reaching safe conclusions in water management.

AMBIGUITY: Unclear information or lack of adequate information.
LACK OF RELIABLE DATA: Water source conditions as well as water consumption in relation to safe produced water is a major problem.

VUCA & Water Security



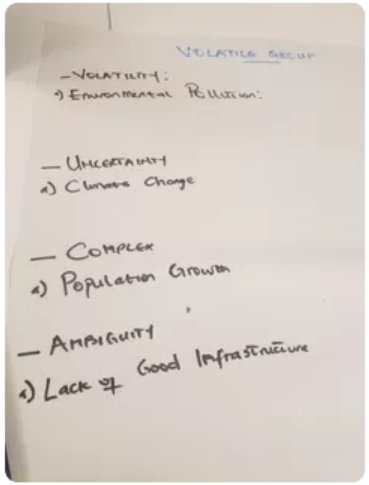
Presentation

Importance of Water: water is an essential part oh human, it is not only essential to health but impacts agriculture, poverty reduction, environment conservation and education

As at 2022 2.2 billion billion people lacked safely managed drinking water

Challenges currently affecting water security:
1. climate change
2. Population growth
3. Urbanization - economic growth
4. Relationship between countries
5. Poverty
6. Inequality (Lack of Developed technology)
7. Lack of natural resources

4 Elements of VUCA affecting water security.



Water supply is an important constituent of life as all lives depend on water. For that reason, it is well captured as no. 6 of the 17 goals of the United Nations Sustainable Development Goals.

The VUCA factors affecting the water security are briefly discussed as follows:

-Volatility
1. Environmental Pollution: The improper disposal of environmental waste causes pollution of water bodies leading to a problem of water security.

UNSDGs

Sustainable Development Goals:

- 17 GOALS, 169 TARGETS, 244 INDICATORS
- Universal, Indivisible, Transformative
- 5 Pillars: Planet, People, Prosperity, Peace, Partnership
- 3 Dimensions: Economic growth, Environmental protection, Social inclusion

Group Discussion Task:

- Take a wider approach to "defining the problem" when considering engineering solutions.
- All groups will consider UNSDG challenge UNSDG 7 (Affordable and Clean Energy)
- Each group will also consider a second assigned UNSDG to fully explore the interconnectedness and 'wicked' nature of the problems.

ALL Groups Goal 7 + second below

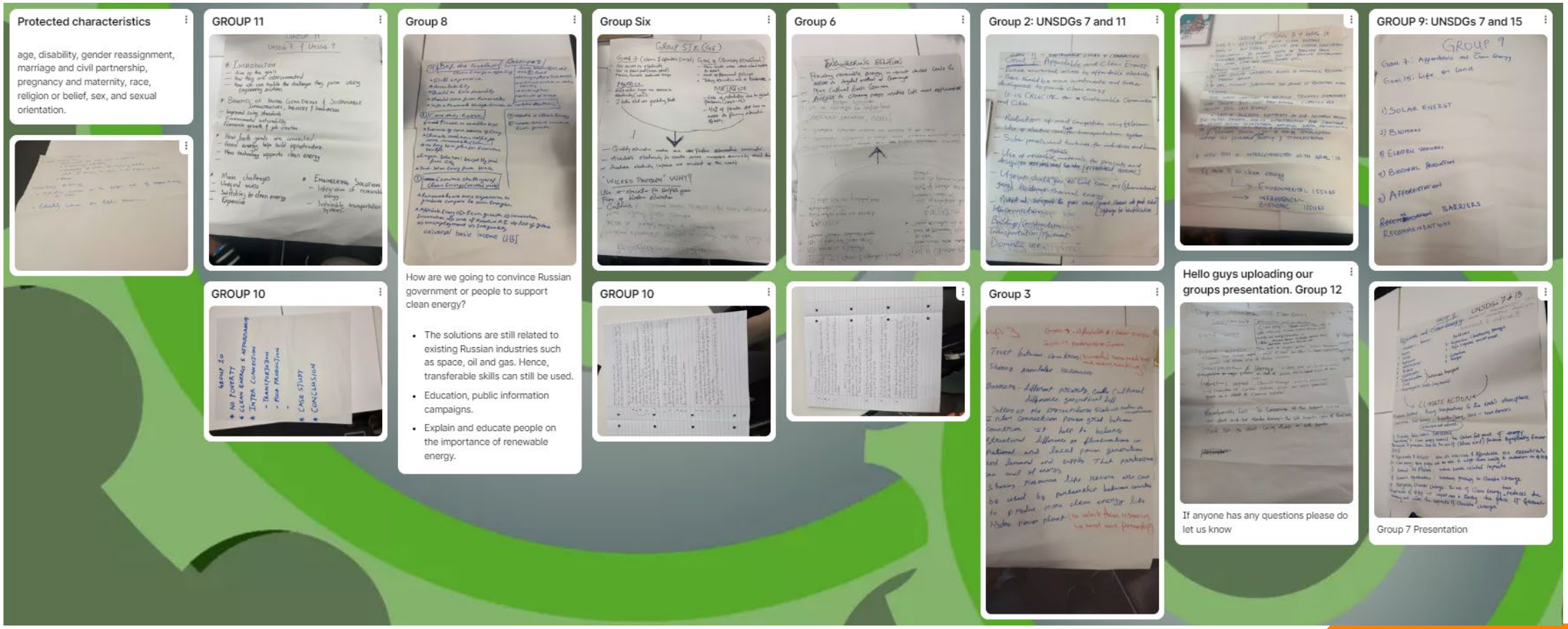
Group	2nd Goal
1	5
2	11
3	17
4	14
5	16
6	4

Group	2nd Goal
7	13
8	8
9	15
10	1
11	9
12	12

Call to Action

Leave No One Behind

Padlet: UNSDGs



Design Thinking

- Models/Approaches
- Divergent & Convergent Thinking
- Solutions: Desirability, Feasibility, Viability
- Value Proposition
- Empathy Tools
- Ideation Tools

Part 2: IDEATION SPRINT – the DIVERGENT PHASE

09:15 – 10:00 Create a storyboard for the problem (similar to customer journey map)

10:00 – 10:45 Crazy 8s / 6 thinking hats / Worst possible idea

10:45 – 11:00 comfort break

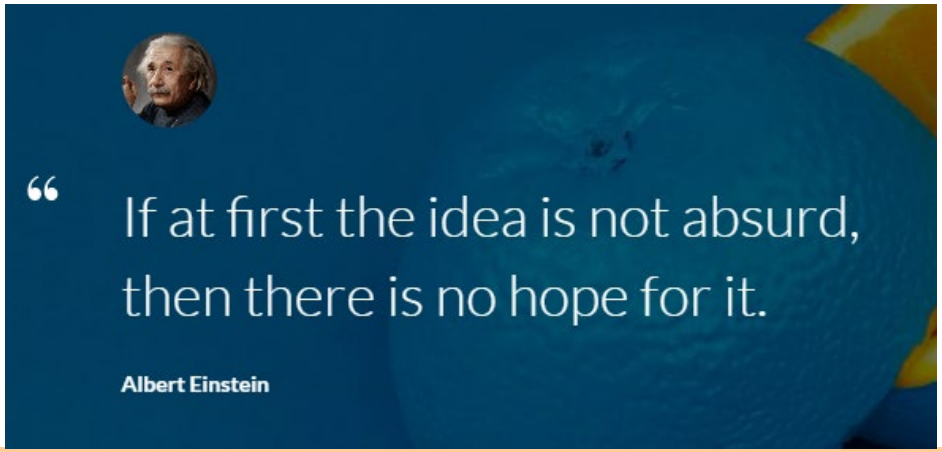
11:00 – 11:45 SCAMPER – apply one of the SCAMPER lenses to develop your group ideas

Part 3: IDEA SELECTION – the CONVERGENT PHASE

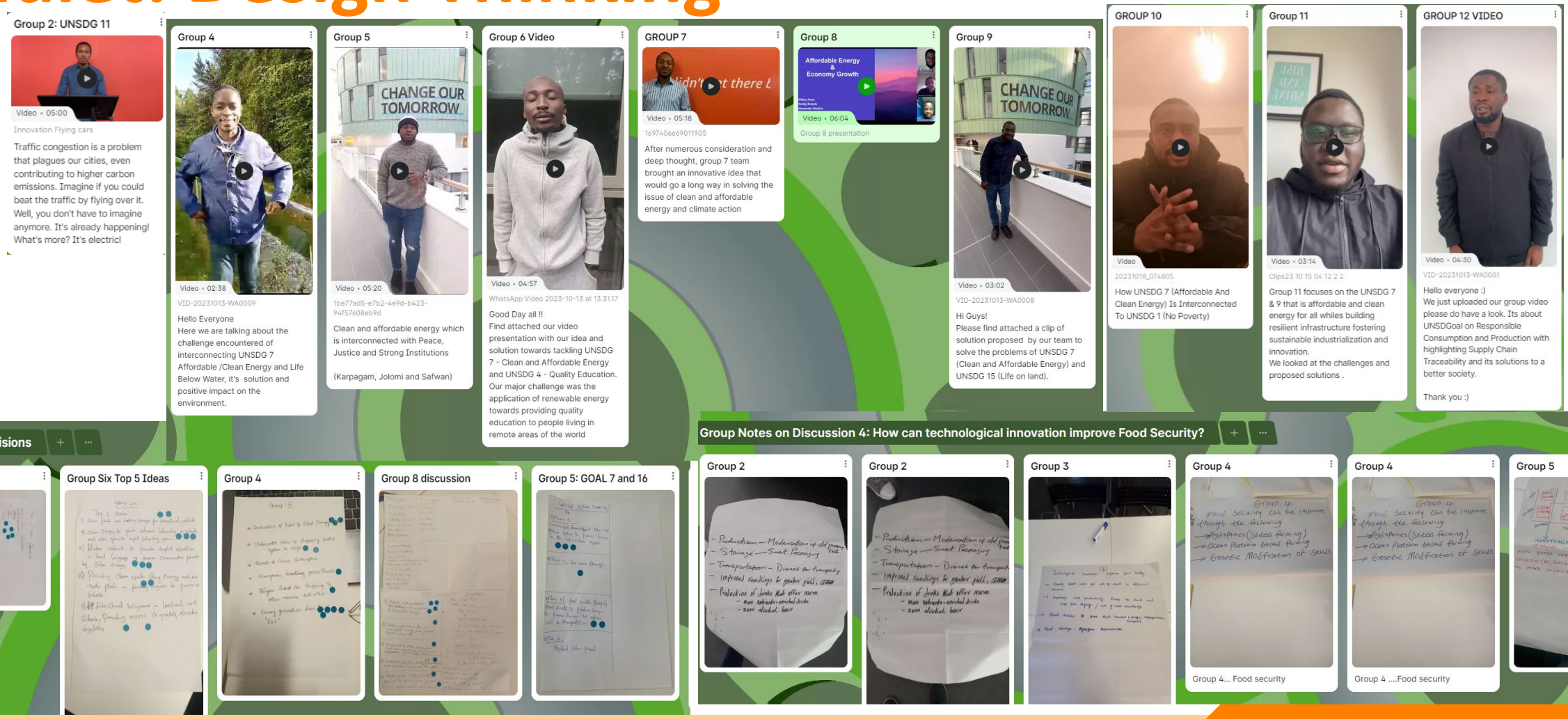
11:45 – 12:30 From all the ideas you have created select one that you COULD take to the next stage (prototyping)

Part 4: Group Presentation

12:30 – 13:00 Groups to create and record a 5-minute presentation that creates a clear and succinct picture of their selected idea and how it addresses the challenge



Padlet: Design Thinking



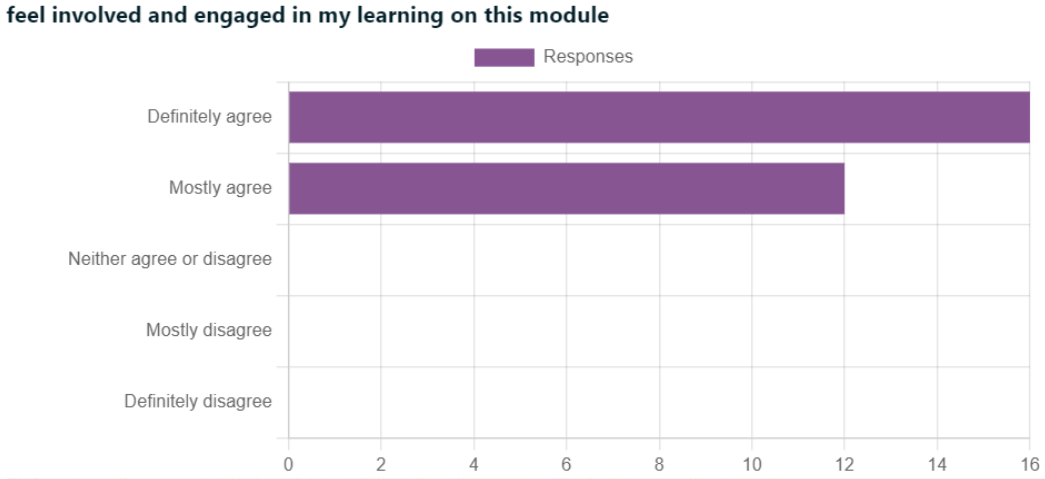
Student Voice Module Feedback

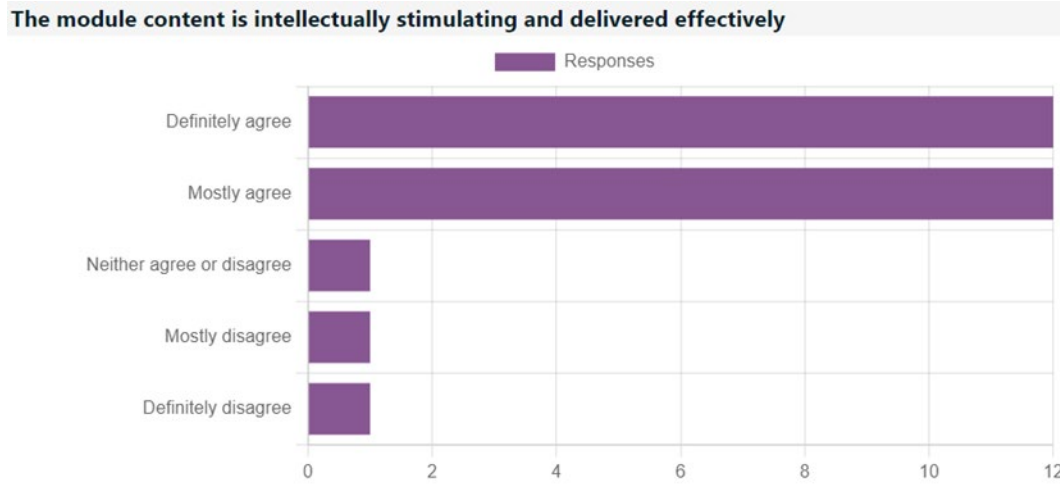
Areas of commendation:

- “The activities have been set up in such a way that all of us students are highly involved and making sure that the way we think is reshaped.”
- “The module delivery is engaging, entertaining, stimulating and captivating. All the lecturers (Chris, Sally, Ibiye and Ruissein) are supportive and friendly.”
- “I believe this module has been beneficial in enhancing various personal and interpersonal skills.”

Areas for improvement:

- “More examples.”
- “I don’t understand the value of this course for my specialization at all.”





Project Teams

PT	Gender	Engineering Courses	Selected UNSDG(s)	Engineering Solution Idea
K	0 F :6 M	4 Oil & Gas; 1 Drilling & Well; 1 Eng. Management	Goal 12: Responsible Consumption and Production	Implementation of new plastic sorting technology can replace hard human job and ensure an efficient process of recycling plastic wastes.
J	1 F: 4 M	4 Oil & Gas; 1 Drilling & Well	Goal 12: Responsible Consumption and Production	Smart tag: Continuous monitoring of food quality across the entire supply chain to enhance consumer awareness regarding the quality of food.
M	1 F: 5 M	4 Oil & Gas; 1 Drilling & Well; 1 Eng. Management	Goal 7: Affordable & Clean Energy; Goal 9: Industry, Innovation and Infrastructure	Production of environmentally friendly lithium-sulphur batteries to reduce energy cost, provide reliable power source, improve the quality of lives and reduce carbon emissions.
G	1 F : 5 M	3 Drilling & Well; 3 Eng. Management	Goal 14: Life Below Water	Robot with a hydrocyclone, as a solution to oil spills.

Project Teams

PT	Gender	Engineering Courses	Selected UNSDG(s)	Engineering Solution Idea
I	0 F: 5 M	4 Oil & Gas; 1 Drilling & Well	Goal 6: Clean Water & Sanitisation	Clean water solution through the implementation of solar water evaporators which use green, easy and affordable energy and technology.
M	2 F : 4 M	4 Oil & Gas; 1 Drilling & Well; 1 Eng. Management	Goal 7: Clean & Affordable Energy; Goal 13: Climate Action	Waste to energy to reduce climate action, reduce mortality rate, clean energy generation, circular economy, land cleaning, and waste management culture.
L	2 F : 4 M	4 Oil & Gas; 2 Drilling & Well	Goal 7: Clean & Affordable Energy; Goal 13: Climate Action	IDAN jacket: Absorbs the body heat from the temperature differentials between the body and the environment to provide a continuous source of energy for devices.

ROBERT GORDON UNIVERSITY ABERDEEN

Advance HE Teaching and Learning Conference

Presentation Showcase

Future-Focused Education: Innovation, Inclusion, and Impact

3rd July 2024

Module Takeaways

Students worked on a group project to identify solutions for one or more of the UNSDGs.

- **Skills development:** Engagement strategies with stakeholders, human-centred, problem-solving, ideas creation, project planning and collaboration, and strategic communication of ideas.
- **Evaluate complexity:** Apply critical analysis, evaluation and synthesis to forefront issues informed by developments in the discipline and society. Deal with complex issues and make informed judgements in situations in the absence of complete or consistent data.
- **Synthesise concepts:** Identify, conceptualise, and define new and abstract problems and issues.
- **Generate engineering ideas:** Develop original and creative responses to problems and issues.

Thank you for listening!