Engineering and Society

Embedding active service learning in undergraduate curricula

Presentation by

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24/11/17
Engineering Education Research Conference

Engineering has an image problem

#11%

isnotenough

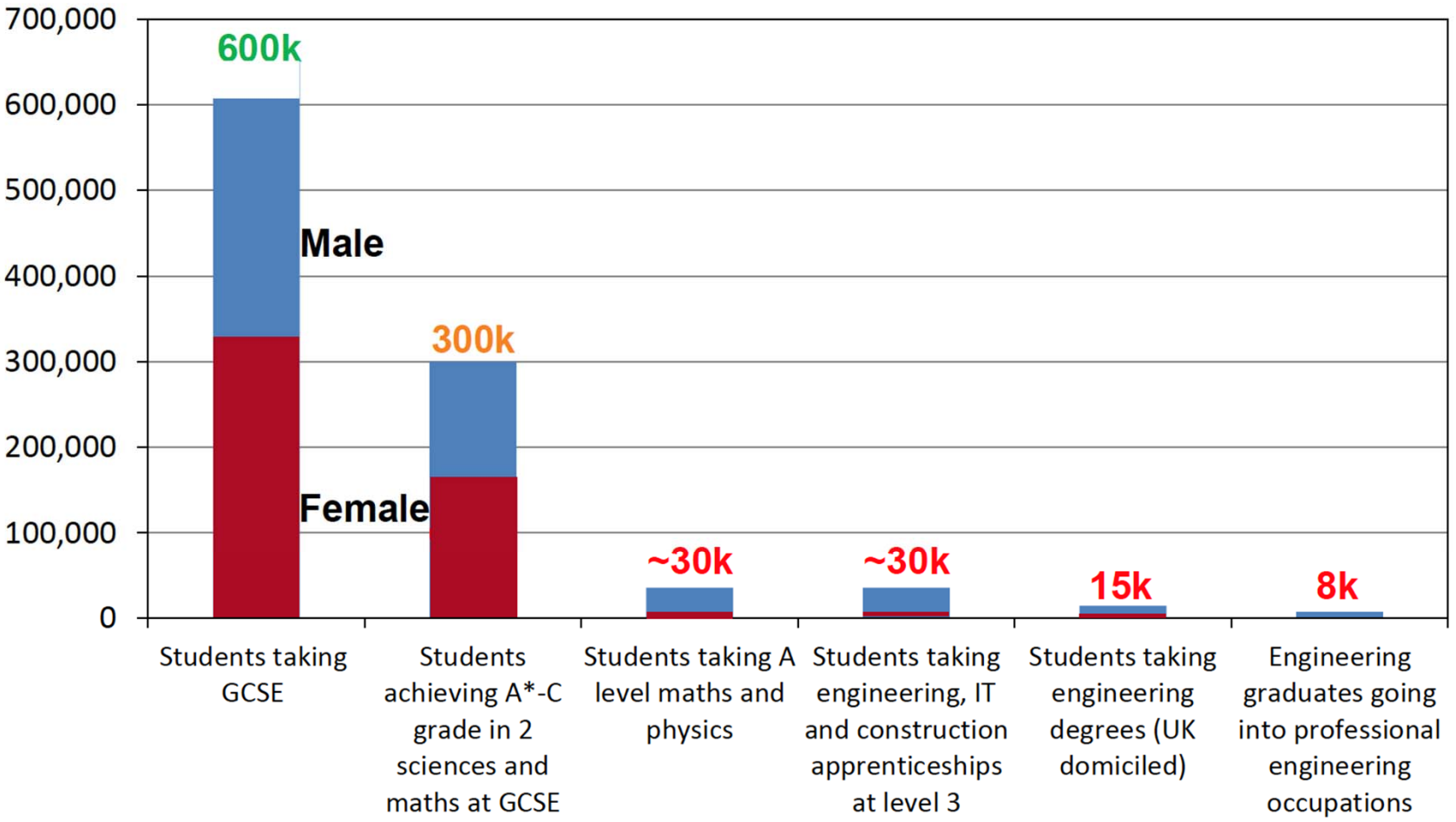
5%

of primary school teachers have a STEM higher qualification

Gender identity is formed between ages

5-7

Overview- The engineering skills challenge



Royal Academy of Engineers

Social Cognitive Theory

"An individual's learning is not only related to their personal capabilities and experience, but also to their observations of others within the context of social interactions, experiences, and outside media influences".

Fogg-Rogers, L., Sardo, A.M., Boushel, C. (2017)

Direct learning

Experience of success and emotional arousal = mastery

Indirect learning

Social norms and social persuasion

Vicarious experience = role modelling

STEM engagement... with whom?

Engineers

- **Improving public engagement skills is a key aim for engineering professional bodies (EPC, 2014)**
- **Recruitment into engineering is needed to meet the employment gap (Engineering UK, 2017).**

Teachers

- **50% of primary school teachers identify low confidence and subject knowledge in engineering (ENGINEER, 2014)**
- **Initial Teacher Education is key opportunity to embed experience in curriculum.**

Key Stage 2 Primary School Children

- **Children, particularly girls, decide on the appropriateness of science as a career before age 11 (Archer et al, 2013).**
- **Girls like connecting STEM disciplines with relevant real-world problems (High Level Group on Science Education, 2007).**

Engineering and Society

New 15 credit module at UWE for third year engineering students

- Importance of “Engineering Citizenship”:
  - Professional development
  - Lifelong learning
  - Competencies and social responsibilities of a professional engineer.
- Understanding of and engagement with the effect of engineering upon society
  - Part of the professionalism demanded by the UK Engineering Council ‘s Specification for Engineers (UK-SPEC).

Paired Peer Mentors

Year 3 Initial Teaching Education students

Public Engagement skills

Engineering knowledge

Year 3 Engineering Students BEng/MEng

Inquiry-based science education

Key Stage 2 Primary School Children

Engineer and teacher training

Engineer training:

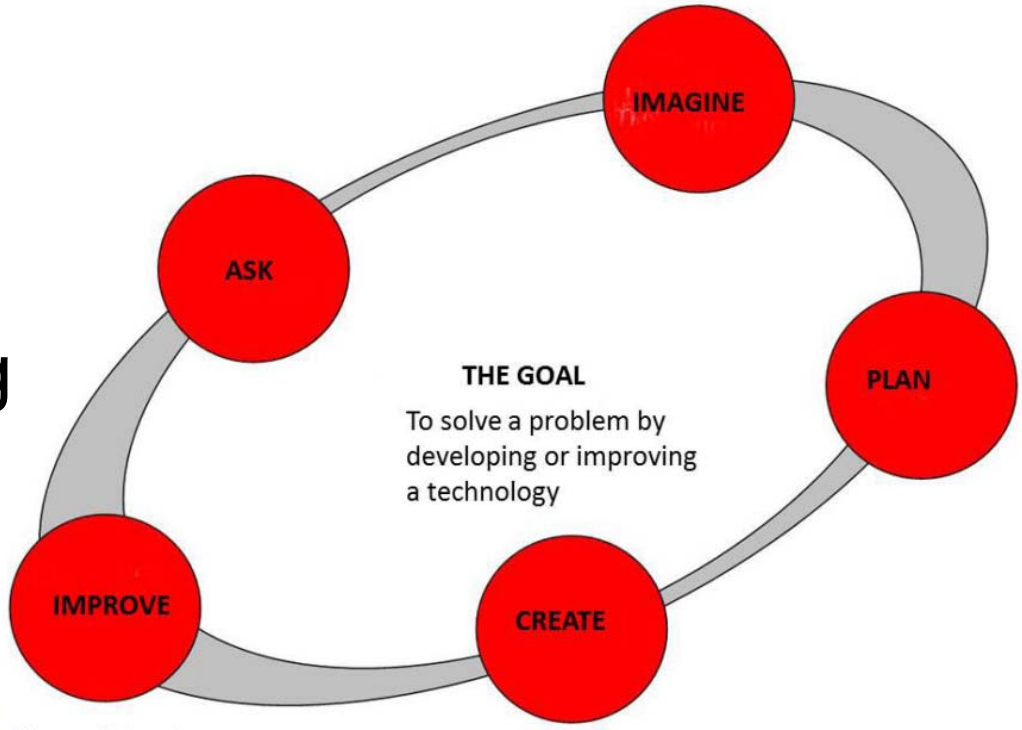
- Communication skills
- Pedagogical theories

Teacher training:

- Engineering Design Process
- STEM concepts

Engineering Design Process

- Force and Balance
- High Flyers
- Mechanics
- Sinking and Floating
- Electricity



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www.engineer-project.eu

Researching conference

Evaluation Design

Student Engineers

Open response questionnaires

Reflective diaries

Perceptions questionnaire

Engineering Outreach Self-Efficacy Scale

Pre-Service Teachers

Open response questionnaires

Reflective diaries

Perceptions questionnaire

Engineering and Science Subject Knowledge Confidence Scales

Teaching Engineering and Science Self-Efficacy Scales

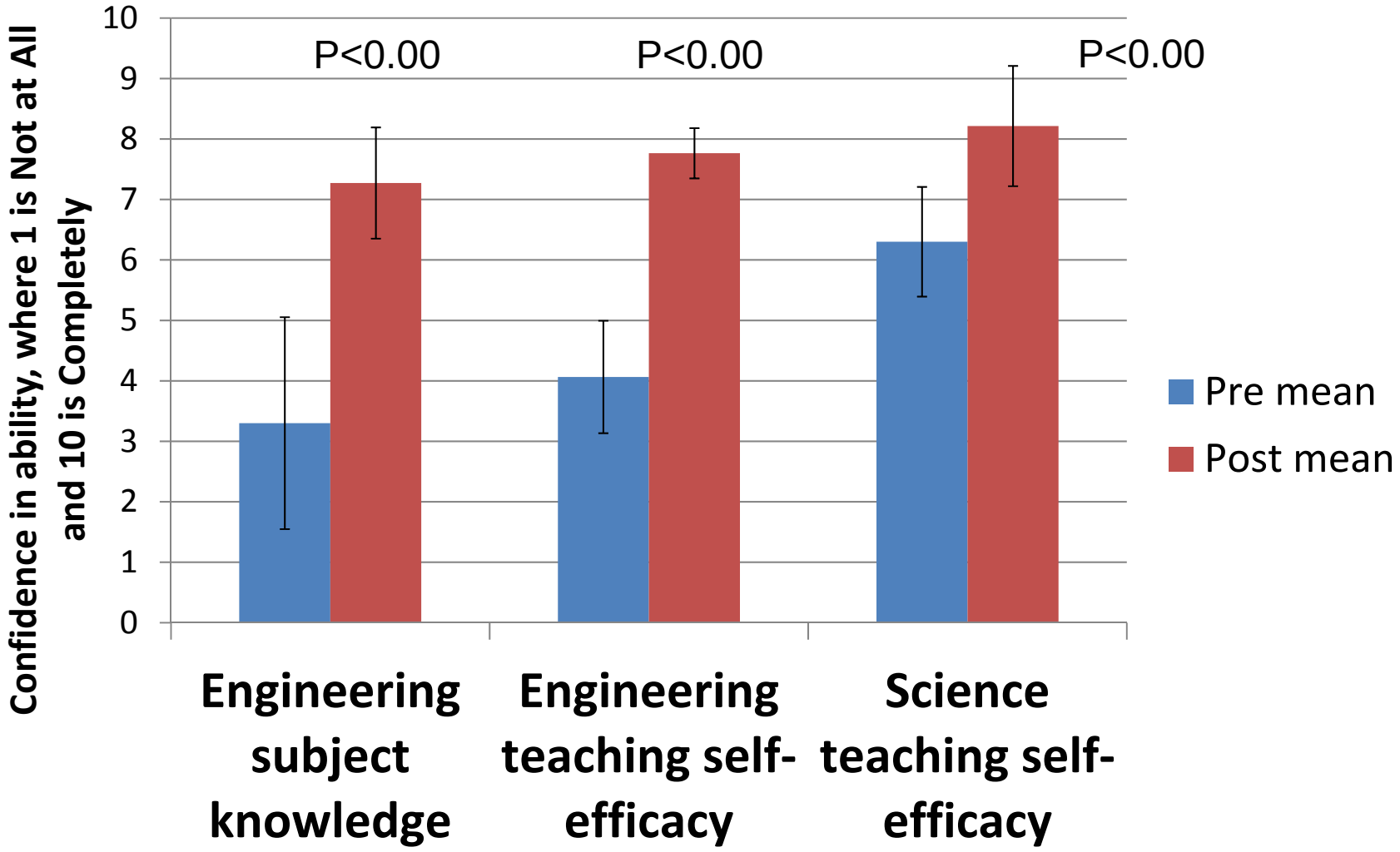
Children

Open response questionnaires

Perceptions questionnaire

Post-it note feedback wall

Self-efficacy



Fogg-Rogers, L. A., Edmonds, J. and Lewis, F. (2017) Paired peer learning through engineering education outreach . European Journal of Engineering Education, 42 (1). pp. 75-90. ISSN 0304-3797 Available from: http://eprints.uwe.ac.uk/29111

Inspiring the next generation

Engineer 9: I've really enjoyed this project because not only did I feel like I was teaching a class, I felt like I was teaching a generation.

Teacher 7: I am excited and confident that I can effectively give pupils motivation. It is an interesting and engaging way to teach science.

Paired peer mentor model

Engineer 10: Working in a pair was very helpful. There were instances where my engineering knowledge was necessary to speak to the class and equal instances where my partner helped knowing how to speak to the children, control the class etc.

Teacher 10: It was useful having an engineering expert during certain aspects of the teaching lesson, as he was able to explain the scientific terms regarding forces - like lift, weight, mass and thrust.

UK Engineering Council's UK-SPEC

Requires skills and proven (evidenced) competencies in the following areas:

A. Knowledge and understanding

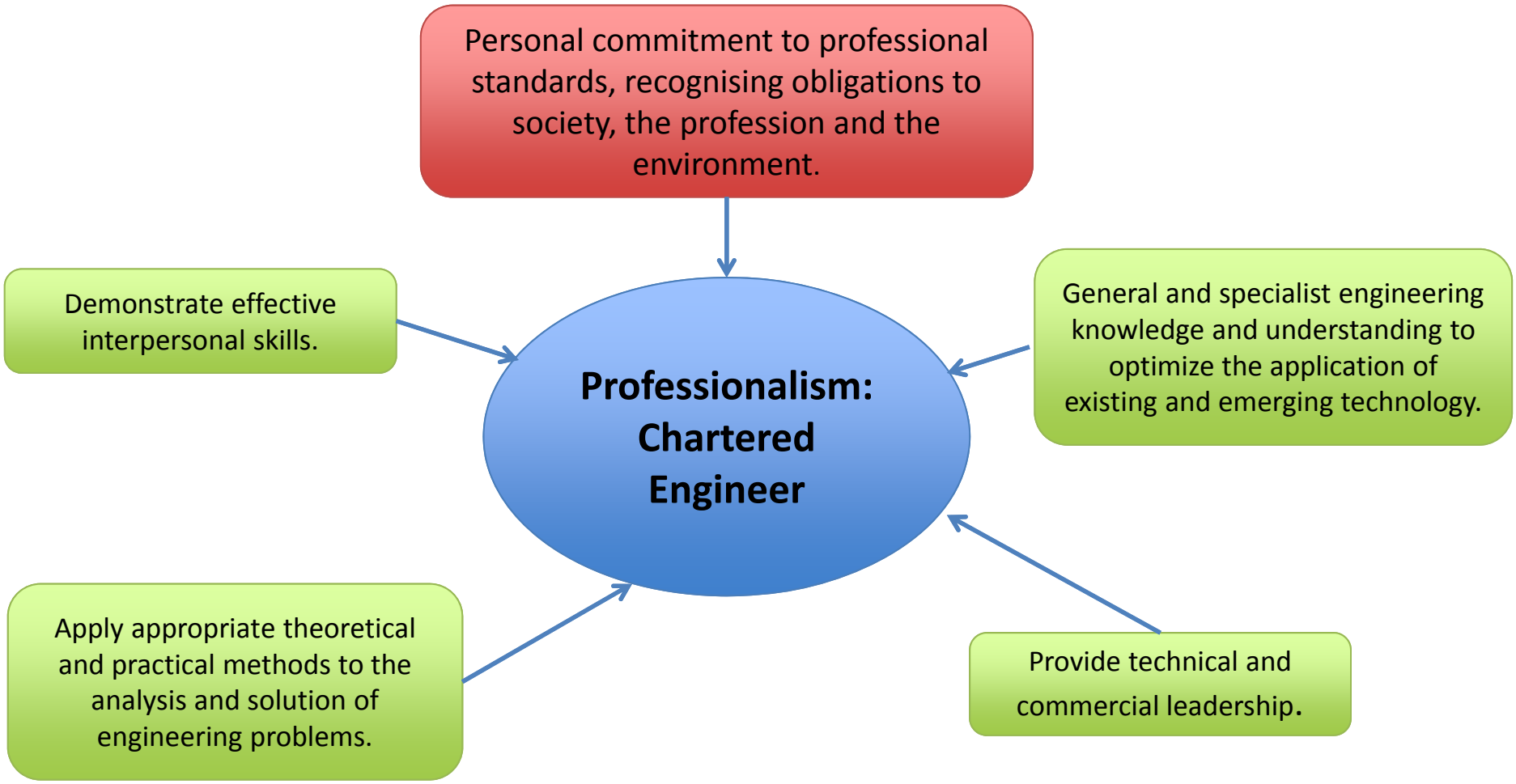
B. Design and development of processes, systems, services & products

C. Responsibility, management or leadership

D. Communication and inter-personal skills

E. Professional commitment

Professional Engineer

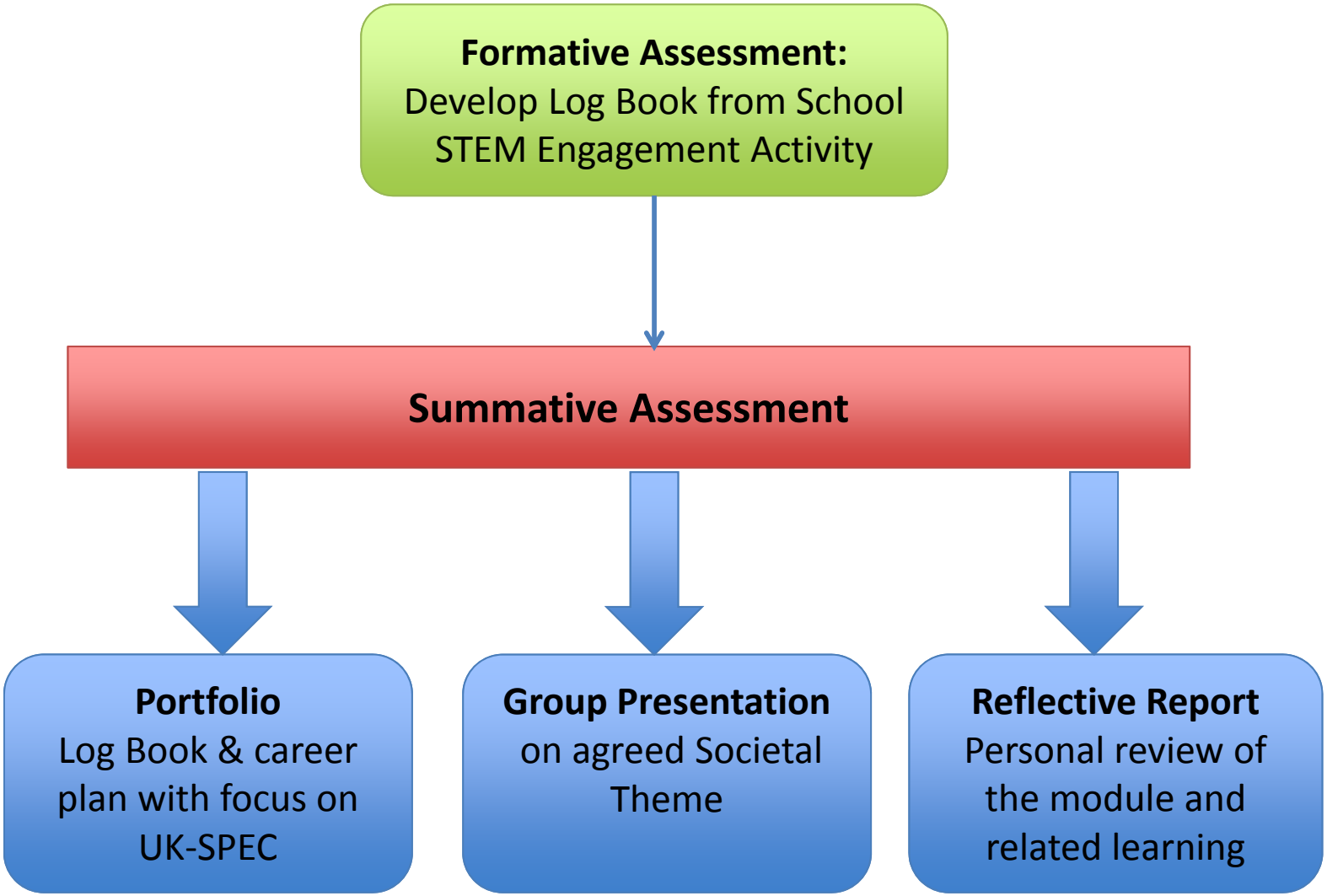


University social responsibility

The module aims to enable engineering students to:

- Understand and critique pedagogical theories and strategies for teaching Science, Technology, Engineering and Mathematics.
- Demonstrate an ability to design, plan, communicate and deliver STEM concepts to different audiences (e.g. teachers & school pupils).
- Develop awareness of ethics and risk assessment in professional practice, including codes of practice, professional standards & workplace ethics.
- Action plan for their future career and personal goals in employment.

Module Assessment



Engineering in a wider context

Competencies

- Practitioner as methodologist – able to choose, use, evaluate methods, techniques, tools and technologies.
- Reflective practice within professional development.
- Instigator for equity within society.

Appreciation of society's issues
Professionalism in determining equitable solutions.

https://curiositybristol.net

Curiosity Connections Bristol

The network for inspirational primary STEM education in the Bristol region

About Stories Coming up Curriculum Toolkits Contact

Welcome

Welcome to Curiosity Connections – the network for people inspiring primary STEM learning in the Bristol region. Have a poke around and explore what's on offer...

Stories – be inspired by other

Sign up for our monthly email network newsletter

Register for our next network event

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