Curiosity Connections
Paired peer learning between engineers and teachers
Engineering has an image problem

#9%
isNotEnough
Engineering has an image problem

9% is not enough

5% of primary school teachers have a STEM higher qualification

Gender identity is formed between ages 5-7
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”.


Direct learning
Experience of success and emotional arousal = mastery

Indirect learning
Social norms and social persuasion
Vicarious experience = role modelling
Social persuasion...
STEM engagement... with whom?

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).

Initial Teaching Education students

- 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.

Student 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).
Paired peer learning model

Paired Peer Mentors

Student Engineers (BEng/ Meng)

Engineering knowledge

Public Engagement skills

Initial Teaching Education students (BA Ed)

Inquiry-based science education

Engineering Design Process

Key Stage 2 Primary School Children

Children as Engineers
Engineering Design Process

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

www.engineer-project.eu
Engineer and teacher training

Engineer training:
• Communication skills
• Pedagogical theories

Teacher training:
• Engineering Design Process
• STEM concepts
Project in schools

Paired peer development of ENGINEER module

\[N=11\] engineers
\[N=10\] teachers

Two half days spent in primary schools

Four schools
\[N=269\] children
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
Children’s responses

**Pre responses**

- **Build/ create things**: 35%
- **Fix things/ make things work again**: 29%
- **Design**: 21%
- **They solve problems/ make life easier**: 2%
- **Make technology**: 9%
- **Has ideas/ make discoveries/ invent**: 10%
- **Fix things**: 5%

**Post responses**

- **Build/ create things**: 24%
- **Fix things**: 5%
- **Make technology**: 4%
- **They solve problems/ make life easier**: 22%
- **They improve things**: 9%
- **Design**: 26%
- **Has ideas/ make discoveries/ invent**: 3%

**What do engineers do?**
Paired Peer Responses

- How useful did you find the initial training?
- How useful was it to work with a student partner?
- How useful did you find the ENGINEER materials?
- How easy was it to organise your activity with your student partner?
- How easy was it to organise your activity with the school?
- How easy was it for you to engage with the pupils?
- How much did you enjoy the project?
- How well did this project meet your needs and expectations?
- How much would you recommend this project to other students?
Self-efficacy

Confidence in ability, where 1 is Not at All and 10 is Completely

P<0.00  P<0.00  P<0.00

Pre mean
Post mean

Engineering subject knowledge  Engineering teaching self-efficacy  Science teaching self-efficacy

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.

**Engineer 6:** I found this project to be tremendously enjoyable and challenging; it forced me to re-evaluate my understanding of mechanical principles so that I could break the subject matter down into lessons that make sense to people.

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

**Engineer 4:** The pupils enjoyed the whole designing and creating process. They also seemed to enjoy the teaching through an activity instead of just talking. I had one pupil say it was their favourite lesson they have done. The teachers were pleased with how much the children enjoyed the activities.

**Teacher 5:** They loved the idea that they were engineers and one child wrote on the poster: “I love science now because it is very fun and not that difficult but my science has improved.” Another, “I thought it was epic I’m going to be an engineer. Thanks” and many more lovely comments. They enjoyed the idea of having the engineer there as well which inspired some of them to aspire becoming an engineer.
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 engineer during certain aspects of the teaching lesson, as he was able to explain the scientific terms regarding forces like: lift, weight, mass and thrust.

**Teacher 7:** I found it very interesting and also beneficial to learn and also to work with an expert.
Engineering and Society

New 15 credit module at UWE for third year engineering students:

This module provides a broad comprehension of the importance of professional development, lifelong learning and the competencies and social responsibilities required for ‘engineering citizenship’ in order to be a professional engineer.

- Science Communication and Public Engagement. Contemporary societal contexts for engineering.
- Pedagogical theories for teaching Science, Technology, Engineering and Mathematics in primary schools.
- Relating at least two taught modules specific to their own academic programme of study (generally at level 2) to societal contexts appropriate for teachers and pupils, and vice-versa.
- Teamwork, partnership working and professional relations.
- Relationships between academe and practice.
- Project and time management.
- Codes of practice, professional standards and workplace ethics.
- Reflective practice and professional development. The practitioner as methodologist - lifelong learning in choosing, using, evaluating methods, techniques, tools and technologies.
- Identification of career and personal goals to support employability.
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...

https://curiositybristol.net
Conclusion

Improving self-efficacy for STEM teaching or public engagement requires:

- Mastery opportunities
- Vicarious experience – watching others who are more experienced than you (role modelling)
- Social persuasion from peer group

To encourage girls into STEM we need to change social norms.

- Use gender inclusive language
- Create peer group support networks
- Show women doing activities – and getting a good response from them