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Published in:

Proceedings of the 7th Annual Conference of the UK & Ireland Engineering Education Research Network

Publication date:

2019

Document Version

Author accepted manuscript

[Link to publication in ResearchOnline](#)

Citation for published version (Harvard):

Muñoz-Escalona, P, Rigmand, D & Dunn, M 2019, Increasing science capital: engineering students inspiring and engaging new and future generations. in *Proceedings of the 7th Annual Conference of the UK & Ireland Engineering Education Research Network: Excellence in Engineering Education for the 21st Century: The Role of Engineering Education Research*. University of Warwick, pp. 150-157.

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Increasing Science Capital: Engineering Students Inspiring and Engaging New and Future Generations Towards Engineering

Patricia Muñoz-Escalona^a, David Rigmand^b and Meg Dunn^c

^aGlasgow Caledonian University. School of Computing, Engineering and Built Environment, Glasgow, UK; ^bBrediland Primary School, Paisley, UK; ^cUniversity of the West of Scotland, Paisley, UK

Corresponding Author's Email: patricia.munoz@gcu.ac.uk

KEY WORDS: STEM, Partnership, engineering, collaborative, Primary School

ABSTRACT

A STEM partnership was built between Glasgow Caledonian University and Brediland Primary School with the aim to inspire and engage this new generation to pursue an engineering degree. Students from the MEng Mechanical System Engineering programme worked along P6 Primary School pupils in the design and manufacturing of a wind turbine prototype.

INTRODUCTION:

Collaborative projects allow not only to learn from each other but also allows to enhance confidence, communication skills and teamwork ability among other aspects. Having university students working together with primary pupils in a STEM project provides different benefit to each of the groups involved, where an enjoyable learning environment can be developed.

Reports show that in 2017 42% of the UK population aged 21-64 have achieved higher education qualification [1]. However, despite an increase in this figure there is a still a need of role models to encourage and inspire the new generation of engineering [2]

LITERATURE REVIEW / RATIONALE

The UK industry is facing an engineering crisis, as figures indicate that there is a shortfall of 20,000 graduate engineers per year [3]. Another factor that is also affecting the industry is the shortage of women engineers, which has been also recognised as a key challenge and that must be addressed if the UK wants to remain competitive [4] and if it wants to be the leading nation for innovation in engineering [5].

To address these issues as academics forming and shaping future professionals in the area of engineering we also need to inspire the new and future generation in order to contribute to science capital as a fundamental part to sustain our society [6].

Reports indicate that the earlier children are involved in STEM activities the better as this reduces building up stereotypes [7]

AIM AND OBJECTIVES / RESEARCH QUESTION(S)

This study aimed to:

- Inspire and encourage primary school pupils to pursue an engineering degree.
- Promote and showcase the different types of engineering involved in the project
- Importance of building and working in interdisciplinary groups.

METHODOLOGICAL APPROACH

A collaborative project between MEng university students and P6 Primary school pupil was conducted as part of the STEM partnership developed by Glasgow Caledonian University and Brediland Primary School.

Two different types of surveys with the purpose of measuring different aspects were delivered to the two groups involved in the project:

- i) MEng students in the area of engineering
- ii) P6 Primary School pupil

Aspects to be measured from each group

- i) Employability skills for MEng Students

- ii) Likeability in different aspects: reading, writing, maths and engineering.

Table I shows number of participants and demographic details. Type of questionnaire delivered for each group can be seen in the Appendix.

Table I. Demographic details of participants

	Number/Ager	Gender	Study	Questionnaire type
1	1/	F	Computer Aided Mechanical Engineering	1
2	1/	F	Computer Aided Mechanical Engineering	1
3	1/	M	Mechanical Electronic System Eng	1
4	1/	M	Mechanical Electronic System Eng	1
5	1/	M	Electrical Electronic Engineering	1
6	5/ 9-10	F	P6 Primary School	2
7	12/9-10	M	P6 Primary School	2

For the activity five MEng Students from three different disciplines, mechanical electronic system, computer aided mechanical and electrical electronic engineering where match with 30 P6 primary school pupils (ages 9-10).

MEng students acted as STEM Ambassadors and worked together with primary school pupils in the design and manufacturing of a wind turbine.

The activity took place over a period of 9 months which included activities that allowed collaborative work, exchange knowledge in the area, increase communication skills, innovating and enhancing practices through real life project. The activity was divided in five main stages

- i) Introduction of MEng students to Primary pupils to advise on their discipline of study and which aspect of the wind turbine they will contribute to.
- ii) Workshops to develop pupils' understanding of STEM specifically in the areas of:
 - Renewable energy
 - Design and manufacturing
 - Data collection (wind speed)
- iii) Field trip to a wind farm for real life experience

- iv) Visit to university's workshops to see how the wind turbine was manufacture, assembled and tested
- v) Presentation to school and Council representatives

Continues communication between the two groups (MEng students and Primary School) were established in order to keep general updates on the projects. Social media accounts in Twitter and Instagram were created for this purpose.

The project has been built having in mind the element of sustainability in order to enhance and improve in the future the outcomes of this first version of the wind turbine prototype and continue the partnership with new and future generation.

Surveys were analysed to obtain key findings

KEY FINDINGS

- After the project was completed the engineering area reported the highest increase of likeability (11%) compared to other topics such as reading, writing and math.
- From the engineering topic a likeability higher than 4 (with 5 being the highest score) was given to:
 - i) I like engineering (4.22)
 - ii) Engineering will allow me to learn many useful things (4.13)
 - iii) Engineering interest me a lot (4.09)
- From the engineering topic the aspects that reflected an increase but with a likeability between 3.0-3.9 (with 5 being the highest score) include:
 - i) I choose to do engineering to learn many things
 - ii) In life, it's important to learn how to do engineering

DISCUSSION

When analysing the differences between answers related to What do engineer do in their jobs? It was observed that before the project ~48% of the pupils used the words "fix things/cars/buses" while after the project ~72% of the pupils used the words "design /create things", 23% of pupils included "Wind turbines" and 27% included words as "make cool stuff"

From pupils comments it can be observed the impact this project has made on them and the importance of their contribution as being part of a collaborative project; i.e.

"I have learned so much about renewable and non-renewable energy! I loved visiting the wind farm and learning from masters' students. I'd love to go to university and learn more about STEM"

“I can’t wait until the wind turbine arrives at the school! I hope the anemometer readings I took help us find the best place to put the wind turbine and generate the most energy”

“I didn’t think I would get the chance to visit University until I was in high school or even later. It was great! We get to visit labs and take part in wind energy workshops”

This was the first time for all MEng Students to interact with Primary pupils and sharing their skills and experience has clearly made an impact in them as well. i.e.

“Being involved in the wind turbine project allowed me to inspire young pupils to practise curiosity and learn about engineering. The project gave me the opportunity to help enthuse the pupils to be involved in STEM, by visiting their school and showing them around Glasgow Caledonian University’s workshops”.

“My experience of the masters project this year was nothing but positive. The addition of working alongside the primary school for this project is something that I really enjoyed, being able to go out and meet the children, talk to them and feel like I was having an impact on them was the best part of the project for me and it is something I would be very keen on doing again”.

“Working with the kids and introducing them to STEM and renewable energy over the past year has been very enjoyable, challenging and rewarding experience. It also presented a challenge in the sense that everything had to be simplified and technical terms couldn’t be used, something I enjoyed adapting to. It was also rewarding to see the kids learn something new and knowing that we had been able to engage and interact with them successfully”.

Having primary pupils and university students working together in a collaborative project develops in them a sense of belonging to a community, where motivation towards STEM topics increases, this helps engagement and interaction and also acts as a driving force to remove labels and stereotypes that have been unconsciously built during many years. This can be related to the results provided by the Scottish Government STEM engagement (Table 2) where a comparison between January 2019 (start of the project) and June 2019 (after project was concluded) can be observed.

Table 2. Children’s perception towards STEM in January 2019 and June 2019

	January 2019	June 2019	Variation
I enjoy taking part in STEM activities and experiences	84%	97%	13%
I think I would be interested in a STEM career	60%	64%	4%
% of girls that enjoy STEM	68%	95%	27%
% of boys that enjoy STEM	54%	98%	44%

Girls were very enthusiastic to see female students as part of the MEng group, and what they have developed as part of their contribution to the design and manufacturing of the wind turbine, these have had an effect on girls enjoying STEM activities as observed from results shown in Table 2.

CONCLUSIONS & RECOMMENDATIONS

Collaborative projects between primary pupils and university students provides an excellent opportunity for longer engagement and the feeling of partnerships/sense of belonging to a community that creates links for the children to education and inspire them to pursue a university degree.

Creating a sustainable project allows to contribute to science capital alongside an insight into multidisciplinary STEM careers.

Having a gender balanced MEng team have helped to increase girls' enjoyment towards STEM career in 27% and boy's in 44%.

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