Science and Engineering Superheroes
Role models in STEM

Evaluation report

1. Project overview and introduction to evaluation

Through National Science Academy funding *Science Made Simple* developed a 50-minute live interactive STEM show for Key Stage 2 students (age 7-11). 'Who Wants to be a Superhero?' features 6 young STEM role models working on a variety of jobs in Wales. Four of the six featured scientists are women. The show addresses the issue of gender stereotypes in girls (and boys) at upper-primary levels. This project offered this show at a subsidised rate to **120 primary schools across Wales**, and provided training to help over **500 teachers** run follow-up activities on gender stereotyping after the show by working in partnership with the 'Let Toys be Toys' campaign on supporting resources.

The project updated the videos of role models to include current and **contemporary scientists and engineers**; these videos are now available online for teachers to use as follow-up resources beyond the scope of this project. **Resources were made available in Welsh and English** and a Welsh/English bilingual presenter was recruited to the Science Made Simple team.

An evaluation framework based on the 'Generic Learning Outcomes' was developed, to monitor change in attitudes and values of students after the intervention. We specifically looked at the change in attitude to careers in STEM of girls (and boys) in an audience sample. We reached **10,513 students** and collected **363 questionnaire** responses (representing approximately 3% of the total audience reached. In addition, we held **four focus groups** with 6-8 students in each group to collect additional in-depth qualitative data around the emerging themes from questionnaires.

Appendix 1 gives the full example of the questionnaire and teacher instructions given to schools for distribution to students. This method was approved as part of a submission to the Cardiff School of Physics and Astronomy ethics committee.

Based on previous evaluation of similar projects from SMS work we aim for 80% or respondents to state the experience was enjoyable, and for more than 30% to say they would like to work in science or engineering when they are older. This represents a significant difference to the average rate for 10-11 year olds, where 15% state they would like to be a scientist when older (ref. ASPIRES study): https://bit.ly/1zaSfpd

Summary of evaluation findings

- 88% of respondents definitely enjoyed the show, with a further 11% stating they 'sort of' enjoyed it.
- The show has increased the number of students who say they would like a job in science and engineering when they are older. The number of respondents who stated 'yes' to this is above the average level cited in other career aspirations studies.
- The largest increase in those answering 'yes' to this was seen from female respondents.
- The show has helped students see the 'helpful' role that scientists and engineers play, and that people working as scientists and engineering are more diverse and more interesting than they previously thought.

1.1 Key evaluation objectives

Objective 1 To explore how watching the show might shape student understanding of, and attitudes toward, careers in STEM (and to differentiate any results by gender)

Objective 2 To explore which role models the students identify with most and why (and to differentiate the results by gender)

1.2 Overview of data

Total questionnaire sample size (n)	363	
Boys' responses	191	(53%)
Girls' responses	157	(43%)
No response on gender	15	(6%)

Focus group data consisted of recorded sessions with facilitated discussion. This has yet to be transcribed and analysed but will form part of the in-depth analysis to be completed in July 2018.

2. Enjoyment of the show

Our objective in terms of measuring enjoyment was to meet the standard expected with our range of shows based on average data collected over our years of operation. We set a target of 80% of audiences sampled stating they enjoyed the show experience and our sample size showed that 88% said they enjoyed the show, with a further 11% saying they 'sort of' enjoyed the show.

The objective of providing an enjoyable STEM experience to a majority of the audience was therefore achieved.

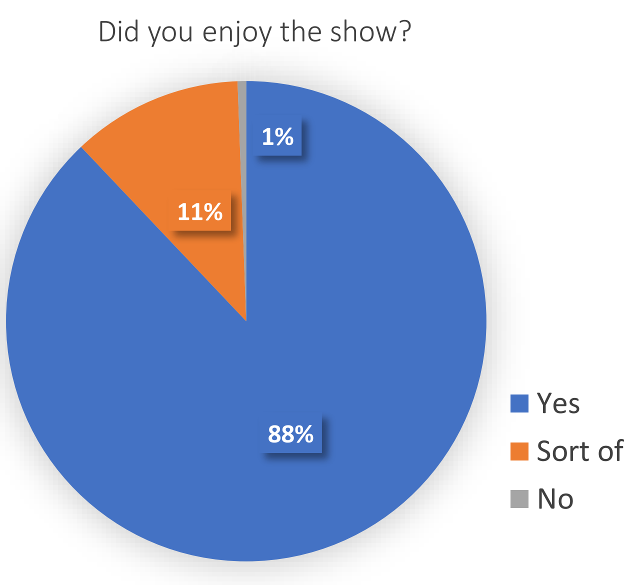


Figure 1: Enjoyment of the show

Headline finding:

88% of the audiences sampled definitely enjoyed the show, with a further 11% stating they 'sort of' enjoyed it. This compares favourably to our standard SMS target set that 80% of all our audiences will enjoy the show given.

Student Quotes:

I liked how it showed that not only superheroes have super powers!

I liked the show because I learnt a lot of new and inspiring things. I was surprised about how much girls were into science.

3. Career aspirations in science and engineering

The show is developed to help students understand how the science they do at school relates to different careers, and to introduce them to a more diverse 'face' of science and engineering.

Students were asked before and after the show whether they would like a job in science or engineering when they are older. As a whole, the cohort felt more positive about jobs in STEM after the show than before. Girls showed a bigger increase than boys in the number who stated 'yes' after the show, with the number rising from 16% to 39%. Boys went from 46% stating that they wanted a job in science or engineering to 67%.

Why would you like that job in STEM?

...because you can help keep people safe and you can save people's lives

...because she can save the planet

...because I liked the idea of the 'poo bus'!

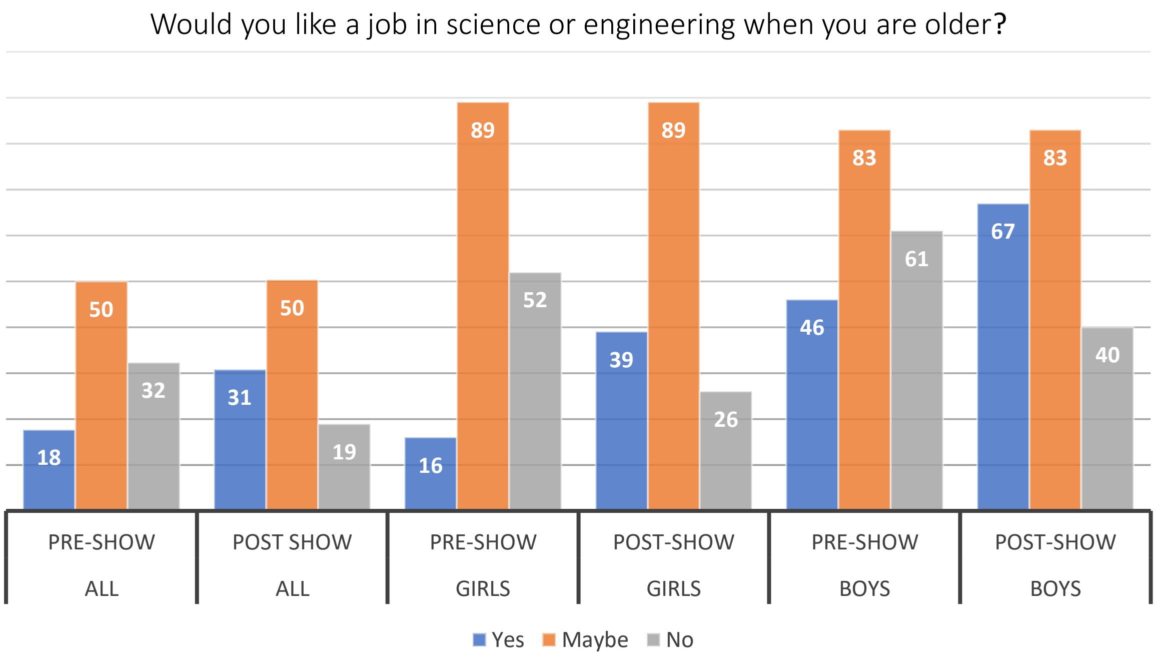


Fig 2: Career aspirations before and after the intervention (and by gender)

Headline finding:

The show has increased the number of students who say they would like a job in science and engineering when they are older. In addition, the numbers who stated 'yes' to this are above the average level cited in other career aspirations studies.

The largest increase in those answering 'yes' to this was seen from the girls who responded.

4. How does the show affect student views on people who work in science and engineering?

Students were asked to choose any of their own choice of three words that they felt described scientists and engineers. We analysed the frequency of words used before and after the show to look for any noticeable changes.

The general trend was that a wider range of more diverse words were used after the show than before, though many of the most commonly used words remained the same in both cases (see figs 3 and 4).

By simplifying the results to look for those words that were used more than 30 times by responders we can see the most favoured descriptors and look for changes in those words (see figs 5 and 6).

Fig. 3: What three words would you use to describe a scientist or engineer? Pre-show responses

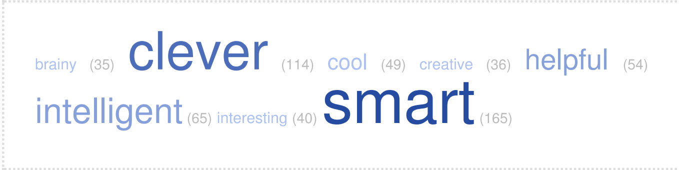
Fig. 4: What three words would you use to describe a scientist or engineer? Post-show responses

The most noticeable difference in the most frequently used words is that the descriptor 'crazy' disappears from the list, whilst the descriptors 'helpful' and 'interesting' appear.

The descriptors around perceived intelligence (brainy, clever, intelligent and smart) all reduced in frequency of use. This is seen as a positive result because many students see the unachievable level of intelligence required as a barrier to pursuing any STEM related work. Although academic scientists require strong exam results to compete in an international market it is not the only route for careers in STEM and also not the one currently with the biggest skills gap (which is in technical level skills).

*Fig 5: All words that were used more than 30 times by responders (**pre-show**)*

*Fig 6: All words that were used more than 30 times by responders (**post-show**)*



It is disappointing to see that the frequency of the word 'creative' dropped slightly – this is another characteristic of science and engineering that we try and promote. It could be explained due to the narrative of this intervention which is about 'Superheroes' saving lives, the planet etc. This perhaps puts them more within the 'helpful' descriptor than the creative inventor type scientist/engineer. These characteristics and the thinking behind them was explored further with the focus groups and results of significance will be reported after July.

> Headline finding:
>
> The show has helped students see the 'helpful' role that scientists and engineers play, and that people working as scientists and engineering are more diverse and more interesting than they previously thought.

5. Self-identity and aspiration towards the role model jobs

Our second objective for this evaluation was to understand more about how effective role models are for both genders, and what characteristics might make them most effective.

We explored two aspects:

1. Which role model they thought they had something in common with and
2. Which role model job they would most like to have

Student quotes related to why they might want a job in STEM:

Because my aunt telled me my lots of science

Because I like rocket science and my Grandad is a scientist

Because I want the same job as my Dad

Our intention here was to explore whether there was an obvious link between those who felt they had things in common with the role models then choosing those jobs as the most attractive. We also wanted to explore whether students tend to select favourites who have the same gender as them. The focus groups went on to explore this in more detail to discover what elements of the jobs were or were not appealing.

Below is a list of the people featured in the show, their field of work and how their (real-life) super power links into the narrative of the show. This is also the order that they appear within the show:

Prof. Haley Gomez	Astronomer (super-power – X-Ray vision)
Lilli Craemer	Civil Engineer working on Bridges (super-power – strength)
Dr Hayley Wyatt	Medical Engineer (super power – saving lives)
Laura Blake	Environmental Scientist (super power – saving the planet)
Edward Kingston	Electronic Engineer (super power – lasers)
Ryan Marks	Aeronautical Engineer (super power – flight)

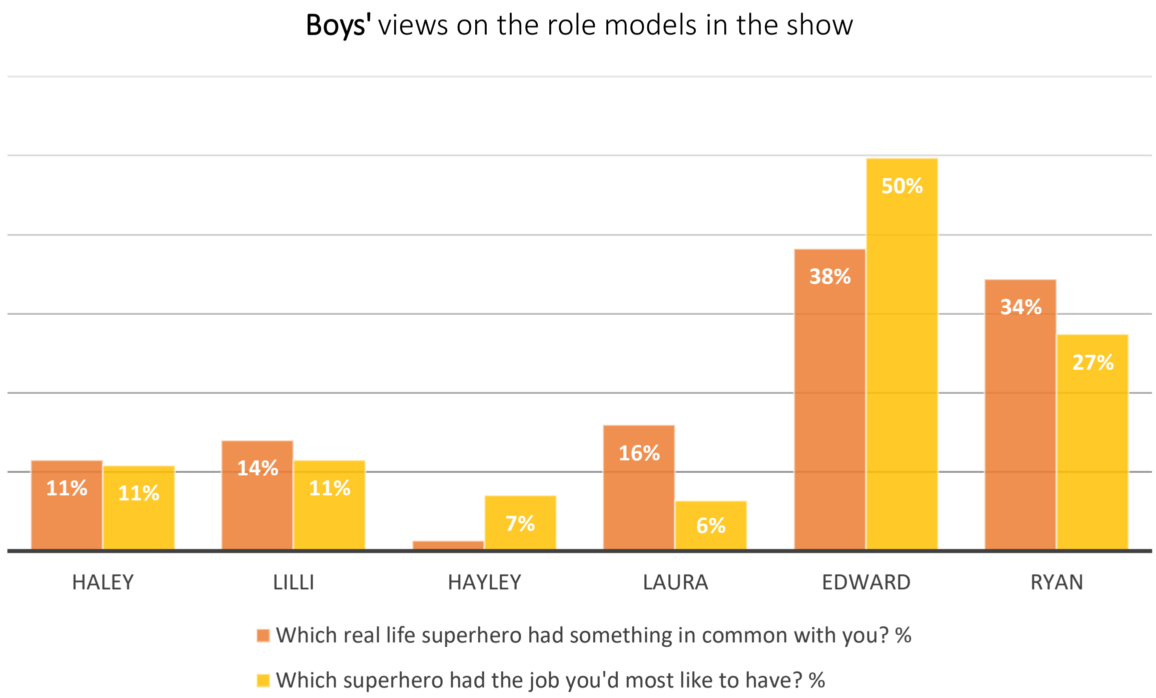


Fig 7: What did boys think of the six superheroes?

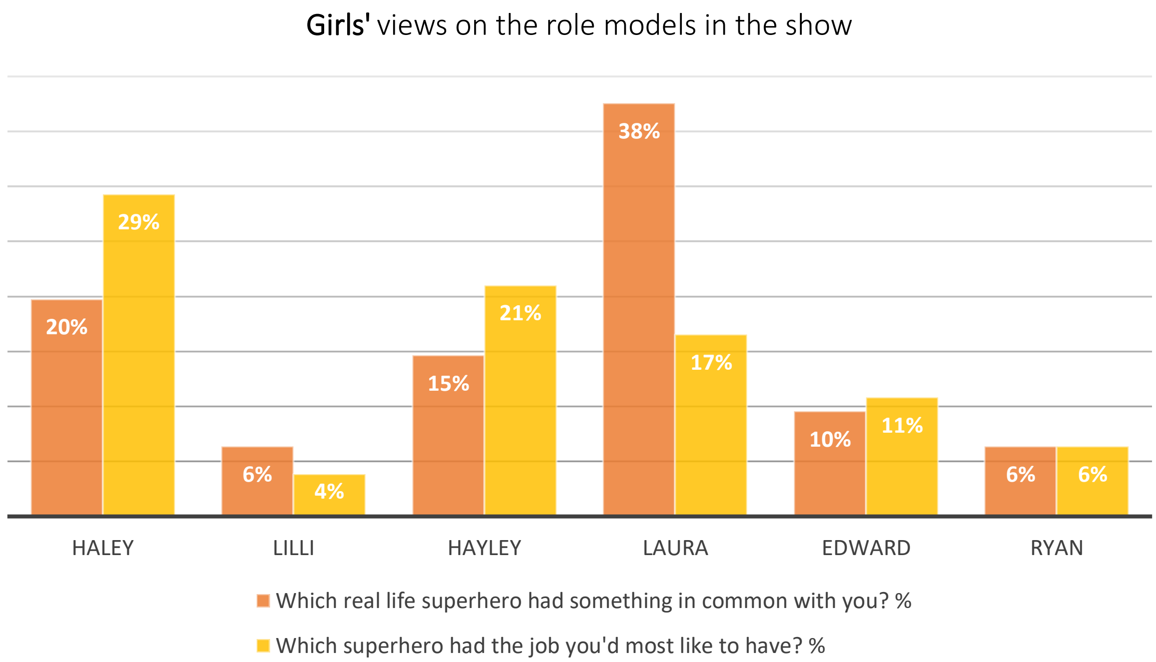


Fig 8: What did girls think of the six superheroes?

It is difficult to conclude from the data alone whether having something in common with a role model makes you more attracted to their job. For some of the role models the data does seems to suggest there is a correlation between relating to the person and wanting that job, but it is not conclusive. It is our intention to delve into the detailed responses over summer to investigate case-by-case how often girls and boys selected the same person for both these questions. We also intend to cross reference the findings here with whether those who are more likely to choose a career in STEM tended to pick the same role models vs those who didn't want to work in STEM. This will hopefully give us an indication of which role models appear to which audience demographic.

The data does seem to suggest that girls on the whole are more likely to relate most (and aspire most) to jobs that they see other women doing, and likewise for the boys, though this was not the case for all responders.

Headline finding:

The data indicates that girls who responded saw more in common with female role models and more often wanted jobs that they did. Likewise the boys more often chose the male role models as the ones they related to and whose jobs they wanted. Some girls and boys did choose role models of the opposite gender but these were in the minority relative to how many role models of each gender there were.

6. Future plans

We have been successful with an application to have an undergraduate student placement through the Cardiff University 'CUROP' scheme to further explore the data we have collected through this project. We aim to develop this into a paper for academic publication to be submitted in September 2018 and will also submit an application to present it at the 'Science in Public' conference in Cardiff in December 2018.

The summer student will assist with:

- Transcribing and analysing focus group data
- Looking for emergent themes across questionnaire data
- Looking for links between those with family members who work in STEM
- Investigating reasons given by boys and girls for choosing certain role models
- Investigating journal publication options

On submission of this report we intend to share headline data via our social media channels and publish this report on our own website to benefit other practitioners.