Invisible Witnesses

Drawing on young people's media literacy skills to explore gendered representations of science, technology, engineering and mathematics

For over 30 years researchers have been trying to understand how young people's, particularly girls', images of scientists, technologists, engineers and mathematicians (STEM) are constructed. Researchers have looked at how children's views of science and scientists are developed as they grow up and why girls' and boys participation in school science declines with age.

Key factors emerging from this work point to a decline in many girls' self-belief in their abilities in science, particularly the physical sciences, as they grow older and their rejection of the stereotypically masculine images of science and scientists as ones that they could espouse for themselves. The images of STEM that some girls (and some boys) are uncomfortable with appears to still be pervasive and does not evolve from the educational environment alone.

The Invisible Witnesses project therefore aimed to investigate the construction of these images beyond school by examining the content and reception of children's television.

The principle aims of the project were to:

- Study the (re)construction of gendered representations of STEM on children's television.
- Investigate the ways in which these images affect children's and young people's perceptions of STEM.

The project has explored these issues firstly through an analysis of the content of two weeks of children's television and secondly via a reception study involving 90 children and young people. The focus of this briefing is the reception study, which focused on young people's media literacy. (The content analysis was addressed in a previous briefing available from http://oro.open.ac.uk/10684/).

Dr. AM. A. Zing (example of the 'Draw-a-Scientist' activity)

We examined how children and young people made sense of the STEM they watch on television. Several research instruments (questionnaire, 'draw-a-scientist', analysing extracts from television programmes and reflective writing about their future selves as scientists) were used to elicit children and young people's perceptions of STEM and their place within these fields in the future.

Media literacy is 'the ability to access, understand and create communications in a variety of contexts'

(Ofcom, 2004)

Why focus on media literacy skills?

A key premise that has underpinned the reception studies is that children and young people are not simply passive receivers of media messages, but active viewers and interpreters of media representations.

We have argued that this process of interpretation plays an important role in the ways in which children and young people actively construct their sense of self-concept and their identities.

- Access - the ability to locate media content that is appropriate to one's needs, and to avoid content that is not.
- Understand - what users do when they have located content, including the interpretation of media forms and conventions, such as:
  - distinguishing between fact and fiction;
  - construction of positive/negative representations;
  - the use and purpose of stereotyping;
  - the possibility of bias and misrepresentation in factual programming;
  - reflecting on their own emotional responses to media content and understanding the strategies deployed by programme makers to create those responses.
- Create - extends the notion of literacy from 'reading' to 'writing' in media and facilitates active engagement with media representations.

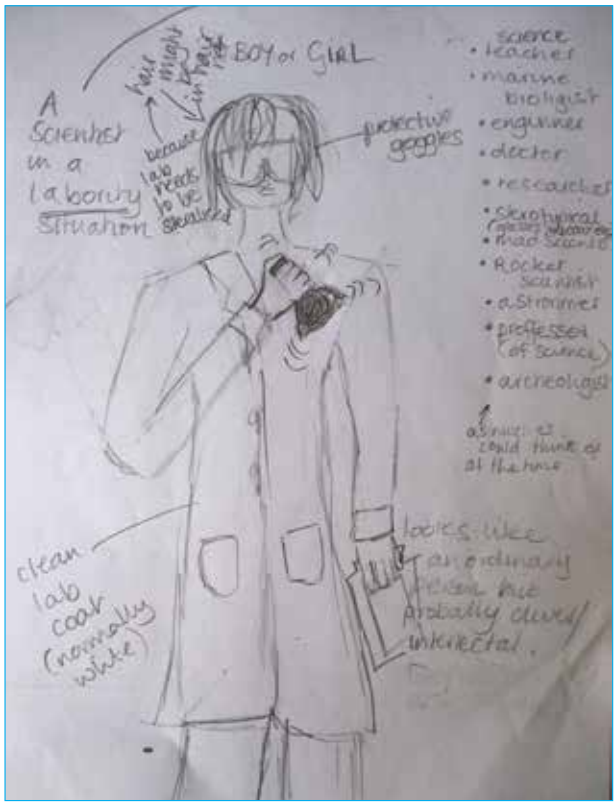
(Adapted from Buckingham, 2005)

The methods used within the studies have been designed to engage with, and capitalise on, the participants' media literacy skills.

Do you know a Scientist or Engineer?

Slightly less than half of those who completed the questionnaire said that they knew a scientist or engineer; only eight of these were female. All the primary aged children defined engineers as 'people who fix things' (e.g. washing machines; cars; quad bikes; showers; tractors). The older participants, however, used terms such as 'design' and appeared to have a broader understanding of the types of work that engineers might do. Whilst it may not be surprising that the older participants have a more sophisticated understanding of the jobs that engineers might do, these age-related differences also highlight the potential for other representations, such as those experienced through television, to enable children and young people to imagine a more diverse set of roles for engineering.

Very few participants identified STEM as a subject more suitable for boys than girls. Interestingly, more girls (54%) than boys (38%) said STEM was important for them. It was, however, mostly the younger children who identified a possible future for themselves working in STEM. This is in keeping with other research findings suggesting that liking for science declines with age.



Drawing of a gender neutral scientist

Dr Ben Dover (example of the 'Draw-a-Scientist' activity)

What do Scientists look like?

We asked the participants to 'draw-a-scientist' and then give them a name. 73% of the drawings of scientists were identified as drawings of males. Only seven drawings were of female scientists and all of these were drawn by girls. Six of the drawings identified by the research team were identified as gender neutral. Once again, all of these were drawn by girls.

On average, the drawings done by girls had fewer stereotypical signals of science and scientists than those drawn by boys. Three girls drew pictures of themselves, but only one of these drawings contained any definite indication that the girl was drawing herself 'as a scientist'. One girl drew an androgynous figure with added notes implying that scientists could be either gender. In this respect, this participant demonstrated a sophisticated understanding of the nature of stereotypes and role models. These findings are consistent with other recent large-scale 'draw-a-scientist' tests where images of female scientists have also been produced by girls, but very rarely by boys.

What sort of scientist or engineer would you want to be?

In order to examine whether the participants saw a place for themselves in STEM in the future we asked them to undertake a reflective writing activity, where they imagined themselves as adults working in a STEM career.

Of those who identified themselves as scientists, six associated themselves with teaching and the remaining had a variety of careers such as working in: Laboratories and research centres; a sewerage treatment plant; a science museum; offices; and hospitals.

Unlike those who aspired to be engineers, participants felt that scientific careers didn't appear to offer the same conditions of self-employment, or consultancy; and only three of the future scientists mentioned financial reward as an incentive.

Science was seen in the role of 'problem solver' for such areas as disease, environmental issues or within the field of forensics.

> *"When I'm older I would like to be a forensic scientist in the area of medical examiners and coroners as it would be interesting and you would find something new out on every case. It would also give you that feeling of achievement when you have reached the end of the case"*

Several of the participants who described careers in engineering again referred to the mechanical aspects to do with fixing things. Four participants imagined themselves in media-related jobs as a light engineer, a sound engineer, working with pyrotechnics and as a 'game maker'.

Equal numbers of girls and boys put themselves in engineering roles.

The participants felt that careers in engineering offered opportunities for 'problem solving', as opposed to 'problem creating'; independence; status and financial reward; travel; and job satisfaction.

The four participants who imagined themselves as mathematicians all interpreted the role as a mathematics teacher in a school.

What kinds of representations of STEM and gender have these programme-makers constructed?

Whilst the use of stereotypes may provide programme-makers with useful 'short-cuts' in terms of establishing the roles of characters within the plot, we should also recognise that the interpretation of these representations can convey negative messages that young people do not find engaging.

- Participants referred to physical signifiers, including clothing (white lab coats and safety goggles), as a means of identifying which characters represented stereotypical scientists. They reasoned that this indicated that "science can go wrong really easily".
- Characters who wore spectacles were identified as being 'clever' or 'geeky' and therefore good at STEM because "it's really complicated".
- Participants identified examples where scientific experiments led to negative outcomes (creation of monsters, for example) as stereotypical.

Young people can, when encouraged to do so, interrogate the contexts in which these images are represented. It is important for programme-makers to recognise the significance of contextual information and young people's abilities to interpret quite nuanced aspects of storylines, if they are presented to them in a way that they find engaging.

- Scientists: mad or genius?

  An extract where a scientist carried out an experiment that would enable him to stay young forever led to a debate about the stereotype of the mad scientist.

  Was he mad to want to carry out the experiment in the first place or was it the result of the experiment (he turned in a monster) that made him mad?

  Some participants argued that if the scientist were mad he would not be able to carry out such a complicated experiment.

- The emotional woman?

  An extract where a female captain of a spaceship led to a debate about whether 'being emotional' was a stereotypical female characteristic. Some participants argued that given the circumstances in the story the emotional response was justified, and that this was a 'human' reaction rather than a 'female' one.

Creating a television series for children and young people that promotes STEM engagement

We asked the participants to work in groups to design and plan a television series about science, technology, engineering and/or mathematics. The tasks included providing an overview of the series; storyboarding an episode of the series; thinking about promoting the series through a website and merchandising; and writing a letter of recommendation to a producer suggesting which series should be commissioned and why.

This proved a very rich source of data, with the participants demonstrating sophisticated media literacy skills when creating ideas for their own television programmes.

The participants demonstrated a good understanding of genre and of programme formats.

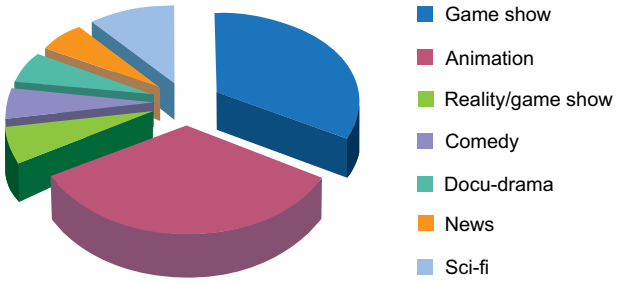
With one exception, the participants chose to 'embed' the STEM content in genres that they felt would be more appealing to children and young people.

Two of the most sophisticated ideas involved combining genres. ***'Children make their mark'*** combined an engineering game show with reality TV and Sound engineers on tour combined a drama with documentary-style STEM content.

All the game shows designed by the participants included comedy elements.

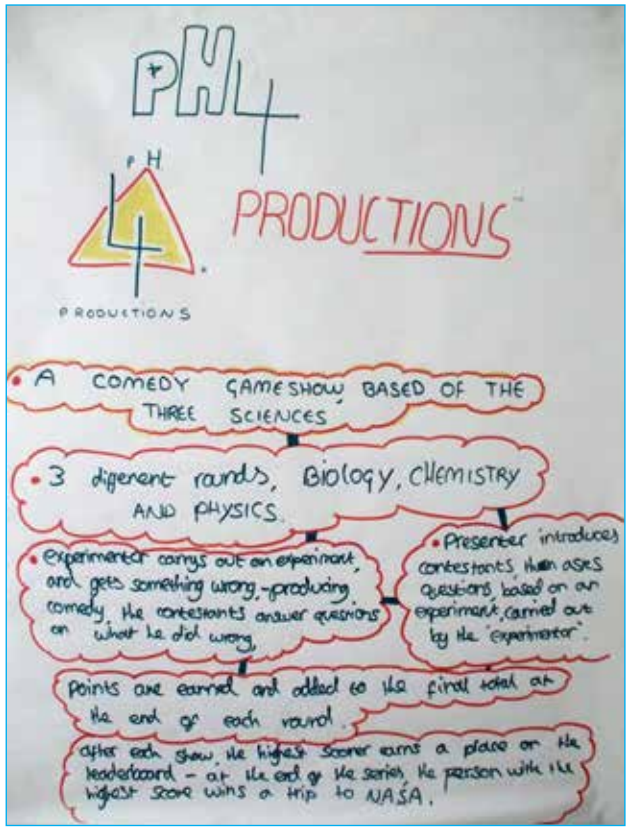
Animated series were aimed at audiences who were younger than the participants themselves and focused on encouraging children to learn about STEM in an engaging way.

> *"Teaching children new facts without the traditional teacher approach"*



Genres chosen by participants

> *"They will grow up learning about it and will have a better knowledge of it whilst learning it in a fun, happy way"*



Planning a TV series

Focusing on storyboarding individual episodes of the series encouraged the participants to think about the personalities of the characters in their programmes.

The participants did make use of stereotypes, for example, the 'mad scientist', in both game shows and animated programmes.

Some groups did, however, create characters that constructed both scientists and engineers as 'problem-solvers'.

When using 'real life' people to present quiz shows some groups felt that celebrities were more likely to appeal to their audience than "really sciency scientists".

Merchandising and websites

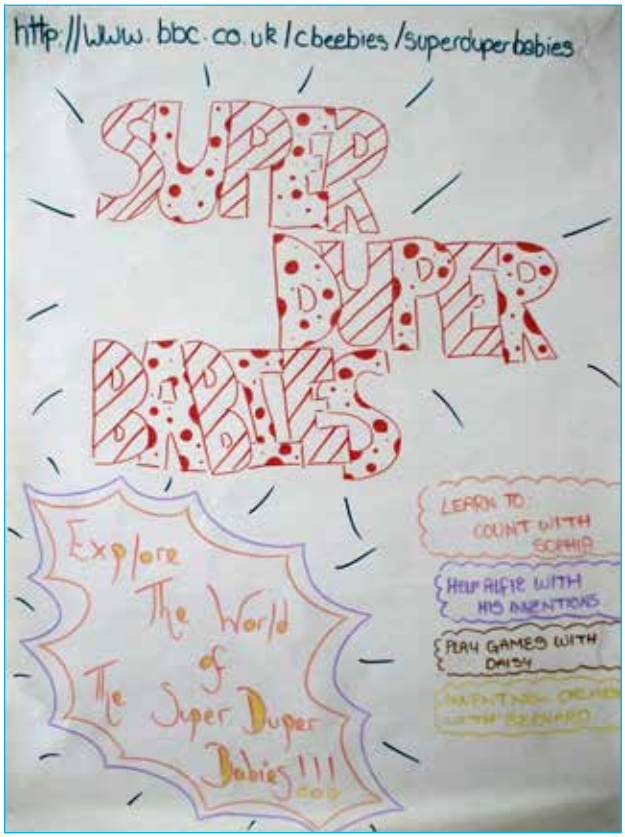
All of the groups demonstrated a good understanding of the content that programme-related websites might contain.

All groups included some level of interactive content, including links to social networking tools such as Facebook and Twitter, and the potential offered by cross-platform activities e.g. mobile apps, games produced for hardware such as Microsoft X-Box.

Some of the more sophisticated examples used the websites to promote the educational aspect of their programmes and explicitly recognised the potential for programme-related websites to be used as a way of engaging the audience in STEM-related activities.

The range of supporting merchandise tended to focus on the types of products that children and young people are regularly exposed (e.g. T-shirts, lunch boxes) rather than products that may have the potential to promote STEM as such. The participants did, however, demonstrate a concern for the 'ethical sourcing' of the products.

Promoting a series on the web



Promoting a series on the web

Letter of recommendation

Each participant wrote a letter to an imaginary TV executive recommending which series should be commissioned.

The majority of participants rated the entertainment value of the programme they had selected very highly, but they also commented that alongside the programme being fun and making the audience laugh, it was important that it enabled something to be learnt.

> *"It promoted science through sci fi comedy which contained factual information about science, maths, engineering and technology"*

Participants felt it as important that the programme provided an opportunity to show the active nature of STEM, and should have opportunities to join in the STEM activity rather than just watch as a passive viewer.

> *"It seems like small kids will like to watch as its adventurous and it will also improve STEM because they have to do activities."*

Use in the classroom

A focus on media literacy skills provides opportunities for developing teaching activities around science which links skills and interests in creative writing and media with science learning. Invisible Witnesses activities provide opportunities for doing this during cross curricula days in school.

A complete school day is needed to run the Invisible Witnesses activities with a class of students. The busiest part of the activity is designing the TV series so it can be advantageous to start the whole activity after lunch to allow the longer session to take place in the morning of the next day, but this isn't essential. The activities are suitable for any age group, although it may be particularly useful to run the activities with years 7 (aged 11-12 years) and 8 (aged 12-13 years) if the aim of the activity is to encourage young people to examine their own ideas about images of STEM and those engaged in STEM, at a time when decisions about their future study and careers are forming. The TV extracts chosen for activity 5 must be appropriate for the age group participating. (If the extracts used are from programmes for much younger children, they will not engage with the activity).

The activities are:

1. Questionnaire to elicit pre-existing perception of STEM. (This is best done in advance.)
2. 'Draw-a-scientist' exercise (this can be repeated at the end of the activity if there is time).
3. Reflective writing about working in STEM (this could be done in advance or as homework between days one and two).
4. Class discussion led by facilitator about stereotypes and their purposes.
5. Analysing short extracts of TV showing STEM-related content.
6. Feedback from groups on stereotypes in the extracts.
7. Developing a TV series – planning a series; storyboarding one episode; planning associated websites and merchandising.
8. Each group presents their series and single episode to the rest of the class.
9. Reflective writing of a letter proposing the best series for commissioning.
10. Feedback from facilitator on winning series.
11. Evaluation of activity.

Details of these activities are given in the project reports at www.open.ac.uk/invisible-witnesses and http://oro.open.ac.uk/12008/.

Most of the activities are best done in groups of 4-5 students, apart from activities 1; 2; 3 and 9 above. In some instances, single sex groups can work well for these activities, but if mixed sex groups are used, there should be more than a single boy or a single girl in a group of 4-5 students.

Outcomes for the school:

Examination of the students' drawings of scientists and their reflective writing activities will provide teachers with understanding of their students' perceptions of STEM and those working in STEM which can be used to inform the school about the values and expectations that students hold about STEM. This may highlight an area for action by the school.

Outcomes for students:

Making explicit the purpose of creating representations of STEM and how stereotypes are used to create these representations can help students to challenge negative representations and see beyond these to a more authentic and diverse image of STEM and STEM professionals, one that they might wish to engage with in the future.

Key messages

- TV is a powerful medium in which to offer new representations of STEM – ones that will appeal to all, including girls.
- Young people are able to deconstruct stereotypical representations, so it is important to present diverse images of scientists on screen alongside the stereotypical ones.
- It is important that male and female representations are authentic in order to show what it means to be a scientist in the 21st century.
- Children and young people demonstrated the ability to accurately recall STEM-related storylines from a range of television programmes and interpret the personalities of characters, identifying both positive and negative connotations.
- Animated cartoons provide a significant cultural resource where children have access to images of STEM.
- During the content analysis phase of this work (see Research Briefing no. 8 available from http://oro.open.ac.uk/10684/) animated cartoons showed the greatest gender differences in words spoken by males (70%) and less than 30% by females, showing that the stereotypical male scientist remains strong in this genre.
- The young people remembered the images presented in animated cartoons long after these programmes were broadcast. They are therefore likely to have a significant impact on how children and young people conceptualise STEM, particularly as they are part of long running series and are often repeated.
- There were very few instances where the participants identified a programme as containing mathematics, which suggests that children and young people have very little exposure to representations of maths and so may not think about engaging with this area in the future as a career.
- Participants use certain indicators (e.g. body language, how other people react to the expert, the job title on the screen) to identify which characters within programmes are STEM experts, and have some difficulty identifying those experts when those indicators are not present.
- Engagement in these activities can be seriously restricted by participants' lack of confidence in presenting their work to their peers, resulting in limited opportunities for learning using creative contexts such as these.
- Young people are able and enthusiastic to use science in developing ideas for TV programmes so can make important contributions to development of scientists' characters for children's TV.

Developing a TV series

Copies of the project reports are available from www.open.ac.uk/invisible-witnesses.

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