



Research Report

(In)visible Witnesses

Using creative media literacy skills to
raise aspirations in STEM

Elizabeth Whitelegg, Jenifer Carr, Richard Holliman
The Open University, Milton Keynes



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Executive summary

Within the school science curriculum, physics has been identified as the subject that has the lowest take up by girls and by students with low socio-economic status.

Many factors have been identified as contributing to this, chief amongst these are students self-concept in physics - how students see themselves in relation to physics both now and in the future. (Murphy and Whitelegg, 2006; IOP, 2012)

Self-concept develops in many arenas, within and beyond the classroom. The 'Invisible Witnesses' project investigates the contribution of the representations of science on television programmes to the development of students' self-concept in science and in physics, by investigating how they understand those representations. Furthermore it supports students to use their creative media literacy skills to develop ideas for TV programmes that represent science in ways that they find engaging. (Whitelegg et al, 2008; Carr et al., 2009.)

In this enactment of the project, three Open University (OU) researchers worked with 29 year 8 students (12-13 year olds) in a school in the North-East of England that is part of the Institute of Physics' (IOP) 'Raising Aspirations in Physics' (RAP) project. This project aims to raise aspirations of students and their parents from lower socio-economic backgrounds and to encourage them to study physics post-GCSE.

Working in small groups, the students engaged in a range of activities to help them understand the role and purpose of stereotypes in selected science-related TV programmes. Using their media literacy and creativity skills, the students created their own representations of science and scientists which they embedded in their own storyboards for science-related TV series. Each group then pitched their ideas for their TV series to an imaginary TV executive board.

Success in engaging students in activities designed to build students' self-concept is highly dependent of students' feeling of ownership on the process. Students' ownership is embedded in this project by facilitating students' creation of their own representations of science and scientists - ones that they feel able to identify with. This work connects with strategies to encourage development of scientific identities by using role models in

the classroom. The use of fictional characters as role models can also be a powerful tool (O'Keefe, 2013), but as this project reveals, this strategy has more potential when students are enabled to create their own role models rather than have adults' conceptions of role models imposed upon them.

During the sessions, the lack of confidence of the students was revealed as a major factor constraining their ability to present their ideas verbally to their peers. This lack of confidence was enacted in different forms according to gender and emphasises the importance of sensitivity to gendered behaviours in classroom situations.

Introduction

A multitude of factors operate to account for the lower numbers of female students and students with low socio-economic status (SES) who choose to study science, and specifically physics when it is no longer compulsory to do so, post-16. Key amongst this multitude of factors found to influence take up of physics post-16 are students' self-efficacy and self-concept (Murphy and Whitelegg, 2006). For girls in STEM and particularly in physics, there is a decline in both these factors as they progress through schooling so that by the time they reach the stage where they have to make choices over their future subject pathways, their beliefs in their abilities in science (particularly in physics and in maths) have declined and their self-concept of themselves as future scientists has diminished. This can be in spite of evidence of high achievement in these subjects. (IOP, 2012) Many of the factors that contribute to girls' declining beliefs in their own abilities in STEM and their narrow images of themselves as scientists are also found to apply to boys, particularly those with low self-esteem, a factor which often accompanies low SES. They also do not see a place for themselves within science in their future (ASPIRES Project, 2013).

This report is concerned with one aspect of this multi-factor situation, the influence of media representations of STEM and STEM practitioners on young peoples' self-concept in STEM.

In our earlier work for this project (Whitelegg, 2008) we carried out a content analysis of two weeks of TV programmes that had some STEM content, which were watched by children and young people (CYP). This analysis showed that across all genres of programmes (educational; pre-school; news and current affairs; and cartoon and animations) the number of male actors exceeded female actors. Unsurprisingly, stereotypes of STEM and STEM practitioners abounded, but it was counterbalanced to some extent by some real-life portrayals of a number of male scientists and engineers. For female scientists and engineers, this was rarely the case. Real-life female scientists and engineers were scarcely seen, but female presenters who talked about science and technology, particularly on news and current affairs programmes were relatively common. Consequently, we recommended that authentic and diverse images of *experts*

should be used in CYP's educational programmes in particular to promote pluralistic portrayals of STEM in respect not only of gender but also of ethnicity, age and socio-economic factors. Furthermore, this earlier work also drew attention to the representations of STEM and STEM practitioners used in cartoons and animations – the most gendered genre in our sample and pointed to our concern that cartoons and animations '(re)construct gendered images of STEM' (p.36). This led to our recommendation of the potential 'to present imagined, idealized images of STEM in animated cartoons, including ones that feature female scientists and engineers in central roles.' (p.37).

In the subsequent stage of our work (Carr et al. 2009), we developed a series of activities that enabled the CYP in this study to employ their creativity and media literacy skills in order to show how they would like to see STEM represented on TV by designing STEM-related TV programmes that they would like to watch. This work led the CYP to examine the role that stereotypes play in TV programmes and to experiment with different ways of representing STEM from the ones usually presented to them. This work led us to recommend that our workshop activities be developed into materials for teachers themselves to use in the classroom to explore the role of stereotypes in STEM programming and to develop CYP's media literacy skills in this domain. This report contributes to this endeavor.

In this report we describe how we implemented the IW activities in a class of year 8 students (aged 12-13 years) in a school that contains many students who have a range of indicators showing low SES. This was conducted as one of a range of activities for the IOP's 'Raising Aspirations in Physics' (RAP) project. In order to protect students' identity, the name of the school is fictitious and names of students have been changed.

Implementation of Invisible Witnesses project at Woodside

School

The IOP's RAP project has a number of aims that match those of the IW project. These include challenging traditional stereotypes of STEM and STEM practitioners; the importance of developing media literacy skills; raising self-esteem and self-confidence; nurturing creativity; and broadening conceptions of STEM-related careers.

The aims of the workshop at Woodside School were to

1. Help students to understand how and why representations of STEM are created for TV and film and encourage them see beyond stereotypical representations.
2. Reveal how these Year 8 students would like to see STEM represented in film and TV.
3. Develop an understanding of some of the factors that limit students' engagement in STEM.
4. Develop a positive atmosphere about being involved with STEM in an active rather than passive way through involvement in the creative activities embedded in the IW project.
5. Demonstrate that creativity is not only the preserve of Humanities subjects and promote cross-curricula links between the Humanities and Science.
6. Appeal to girls (as well as boys) through the use of creative and media literacy skills.
7. Raise awareness of careers in physics.

Methodology

In advance of the workshop, students and their parents were informed about the content of the workshop using leaflets prepared by the IW team and distributed by the school. Consent for participation and for filming was obtained from the students and their parents beforehand.

The workshop was split into two consecutive half days and run over the afternoon of day 1 and the morning of day 2, and students were asked to complete a reflective writing activity as homework. Details of the activities students were asked complete can be found in Appendix 1.

The workshop involved 29 Year 8 students (aged 12-13 years) who were divided into five groups by their class teacher. Table 1 provides details of the composition of these groups.

| Name of production company¹ | Girls | Boys |
|-----------------------------------------------|--------------|-------------|
| PBMC | 2 | 3 |
| POF Productions | 6 | 0 |
| No Name Productions | 0 | 6 |
| BERCS | 5 | 0 |
| Table Turning Productions | 1 | 6 |

Table 1: Composition of the groups

When designing the activities, the research team drew on the three-fold definition of media literacy. The Office for Communications (Ofcom) defines media literacy as ‘the ability to access, understand and create communications in a variety of contexts’ (2004, p. 2). In his review of the literature of research into children’s media literacy skills, commissioned by Ofcom, Buckingham (2005) explains further what skills are implicated in each of these three elements of media literacy, and emphasises the relationship between them:

‘Access’ refers to the ability to locate media content that is appropriate to one’s needs (and to avoid content that is not). ... ‘Understand’ refers to what users do when they have located content. ... ‘Create’ extends the notion of literacy from ‘reading’ to ‘writing’ in media, although it also entails abilities both to access technology and to understand media forms and conventions.’ (p.6)

The first activity was designed to act as a stimulus for the later activities and addresses, in part, the ‘access’ element of media literacy. As outlined above, previously the IW team conducted a content analysis of two weeks of TV programmes that had some STEM content, and which were watched by CYP. We identified representations of STEM in a wide variety of genres. Our previous experience of carrying out audience reception studies with CYP, however, was that when CYP were asked about STEM content on television they initially tended to identify representations from a much more narrow range

¹ The groups were asked to choose a name for their production company. As the composition of the groups remained the same throughout all the group activities, the name of the production company is used as the group identifier throughout this report.

of genres such as news programmes and documentaries. This first activity includes images from animated cartoons and drama series (see Appendix 1) and encourages the participants to think about a range of sources of media representations of STEM.

The second activity was designed to engage with media literacy skills of 'understanding', in particular analytical skills relating to language, representation and audience. Working in small groups, participants watched a short extracts from a television programmes or a film. These extracts had been chosen by the research team because they contained either stereotypical or counter-stereotypical representations of STEM or STEM practitioners and/or men and women. In the Ofcom review, Buckingham (2005) points out that:

Despite considerable debate about the dangers of stereotyping and well established evidence of systematic biases in the representation of different social groups, there has been relatively little research about how children make sense of such representations (p.16).

This activity required the participants to not only try and identify stereotypes within the extracts but, through whole group discussions facilitated by IW team members, explain their reasons for identifying these particular representations as stereotypical. Other aspects of the activity required the participants to summarise the narrative of the extract (language) and identify the strategies used by the programme-makers to make the programme appealing to children and young people (audience).

For homework, participants were asked to imagine and write a short account (no more than 1 side of A4) of themselves working in STEM/physics when they are grown up. Students were directed to IOP Careers material (see: <http://www.iop.org/careers/i-am-at-school-college/index.html> accessed 11/1/2/13) as a stimulus for this activity.

All of the activities for day 2 were designed to engage with the 'create' aspect of the participants' media literacy skills and focused on participants designing their own television series, story-boarding one episode from the series and outlining how the series might be promoted to CYP (for details of the guidance given to the participants, see Appendix 1).

Finally participants were asked to write a letter recommending one of the proposed series for funding, and stating the reasons for their recommendation. For this activity the participants switched from working in small groups to working individually. The reason for this change in format was to encourage participants to reflect on the presentations that they had seen and write about their personal opinions, rather than having to come to a group consensus.

All the group discussions were recorded on digital audio recorders and presentations to the whole group were also recorded on a digital video recorder. All resources used by the participants during their presentations, for example scripts and illustrations or key points recorded on flip-chart paper, were also retained and used for analysis.

Results and interpretations

Worksheets

The first point we note here is that it was difficult to assess in advance which examples of programmes/films should be used as examples of representations of STEM with this group of students. In previous audience reception studies we have asked for a questionnaire to be completed in advance by participants. This questionnaire included questions about the television programmes the participants preferred to watch. As this particular cohort of participants are involved in other surveys/questionnaires as part of the RAP project it was felt that they may be in danger of being 'over-surveyed' and we were asked not to administer the questionnaire used in the IW project. We selected examples of programmes that were either 'age-appropriate' or that we felt the participants would have engaged with when they were slightly younger, but would remember. Both written comments on the worksheets and the audio recordings of the discussions within the groups as they completed the worksheets suggested a lack of engagement with the activity when examples were from programmes that the participants considered were "for kids" or, as one group phrased it, "for kiddie winkies". In the whole group discussion that followed this first activity we encouraged participants to suggest examples of TV programmes and films that people their age would watch and which contained representations of STEM. Appendix 2 contains the list of sources suggested by the participants. The list includes a very diverse range programmes/films

and suggests that the main aim of this particular activity, to encourage participants to consider the many ways in which they encounter images of STEM, was achieved.

Returning to the examples provided by the IW team (see Appendix 1 for further details), three of the themes that emerged from this activity have also been highlighted in our previous studies (see Carr et al., 2009).

There is a difference between ‘doing’ science and ‘talking about’ science

As noted in our previous studies, the participants do make distinctions between those involved in non-fiction programmes as experts and those who are presenters. Young, attractive presenters, who the participants may identify with, have limited potential in terms of encouraging young people’s engagement in STEM. The exception might be the role of ‘science communicator’, but in order for this to be the case it does need to be made clear that the presenter is a scientist.

Science can be ‘bad news’

When identifying examples of STEM in the Newsround programme the focus was very much on ‘bad news’ stories e.g. the financial crisis, car crashes and nuclear explosions. This contrasts with the examples of STEM identified in relation to fictional programmes, where ‘mysteries are solved’ (Sarah Jane Adventures and Scooby Doo) and scientists are ‘heroic’ (Spiderman).

In their study of students’ views of science Schreiner and Sjøberg (2004) provide a comparison between the views of students in developed countries and those in developing countries. They highlighted that the more positive views of STEM provided by students in developing countries appear to be linked to an understanding of STEM as being key to resolving issues and problem-solving. These students were also more likely to represent scientists as ‘heroic’ and have generally more positive views of the characteristics and personality traits of scientists.

Whilst news programmes and documentaries play an important role in developing CYP’s understanding of the role of STEM in their lived experiences and the society in which

they live, it is important, especially within teaching and learning contexts, that adults emphasise the kinds of narratives that CYP find appealing and engaging.

Lisa Simpson is cool!

In the three previous audience reception studies we have conducted Lisa Simpson (one of the main characters in the US-produced animated cartoon *The Simpsons*) has been identified by the participants as being both good at STEM and being a positive representation of a 'geek' or 'nerd'. The participants in this workshop made similar observations. According to them Lisa is:

- Clever, whitty², smart, intelligent, young, thinks about other people.
- Smart, clever, intelegant, caring, kind, strange, small and cool.
- She is nice, clever and sweet. She is also very determined to succeed her ambitions.
- She plays the saxophone and she is very talented.
- Kind, smart, wise beyond her years.

In contrast to the positive comments about Lisa Simpson images of computer engineer Barbie elicited a rather different response from the participants.

In 2010 toy producer Mattel introduced computer engineer Barbie as part of the 'Barbie I Can Be' range. This doll was created as a result of a public vote on which career the new Barbie doll should represent. It has been stated (for example see <http://www.wisecampaign.org.uk/news/2010/05/new-computer-engineer-barbie-inspires-girls-to-consider-a-career-in-computing-through-speaking-out-on-a-uk-blog> accessed 11/12/13) the outcomes of the vote were heavily influenced by adult female STEM professionals. We included an image of computer engineer Barbie in the set of worksheets where the participants are asked to suggest what the character might be saying (See Appendix 1 for illustration). The participants' suggestions were:

- I love computers! I wonder how much they actually cost.
- Buy my computer
- How do I use this?

² No grammatical or spelling errors made by the participants have been corrected in the quotes included in this report.

- I don't know anything about engineering! I only know about mathematics when I'm trying to add up for my clothes. Science is just a bunch of explosions.
- What does mathematics mean? Is engineering something to do with shoes?
- I have 6Gb memorie for my laptop.
- It's fun
- I love my gadgets there so cool. I'm just worried it will ruin my hair.

Whilst we would not claim that any conclusions can be drawn on the basis of such a small-scale study, we think this does highlight the importance of not assuming that adults' interpretation of what might be positive images of STEM would be the same as those of CYP. In our previous reports we have emphasised the need for those who are involved in creating representations of STEM to involve CYP in the creation of these images and be guided by their insights rather than treating them as passive consumers.

Viewing extracts

The details of the extracts participants were asked to view and the prompts they were asked to consider whilst watching are outlined in Appendix 1.

In previous studies we have had the opportunity to send the participants to separate rooms so that they could view the extracts without being distracted by other groups watching different extracts. Unfortunately we were not able to do this in this setting. Hence, the participants found it difficult to focus on completing the task in small groups, but a whole-group discussion, led by members of the IW team, did illustrate that the participants easily recognised the stereotypical representations of both gender and STEM.

For example, comments about stereotypical representations of gender included:

- Boys seem braver than girls.
- No fat girls
- Girls have all got squeaky voices – ANNOYING.
- The villains were men.
- The stupid person (a female character) was blond.

- Dumb person (a female character) who was blond.
- Superhero was a man.
- Girl who was a scientist wore big glasses to make her look more geeky.
- Boys are smarter than girls

In relation to the use of stereotypes in the representation of STEM, participants highlighted the use of ‘the evil, mad stereotypical scientist’ and that this representation included ‘a Russian accent for the baddie’. The participants highlighted the style of dress that is used to indicate that someone is a scientist:

- Scientists had glasses to make them look geeky.
- The clever people were wearing glasses.
- Coats to make them look scientists.

As we have noted in previous studies, 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.

What type of scientist would you like to be?

As a homework task, participants were asked to imagine and write a short account of themselves working in a STEM field or in physics when they are grown up. Students were directed to IOP Careers material (downloaded from the web) as a stimulus for this activity.

Only five of the participants completed the task as homework, and of those five only two engaged with the prompt questions they were given. However, the whole group participated in a discussion about STEM careers as the first activity on the second day of the study.

Of the five participants who completed this task as homework, two girls wanted to work as forensic scientists. One girl wrote about the influence of TV programmes on her choice of career.

I would like to be part of a forensic science team because I like crime and murder stories. I would like to try and find out who caused the murder, what weapon he/she used. I think this because of TV programmes about crime, such as CSI, Crimewatchers.

The second girl wrote about how she believed would be suited to this type of work “When I’m older I would like to be a forensic science because I like finding things I think I would do a good job of it because I don’t give up”. She also mentioned that “it would also give you that feeling of achievement when you have reached the end of the case”.

One girl wanted to work as vet or an “animal cycyatrist”:

I really like being around them because they are so loving and so like us as humans, I find them so fascinating. Even though some of them are abused or abandoned they still seem so happy and affectionate. I also find their behaviour interesting as they seem to react and adapt so quickly to new circumstances and surroundings.

However, the participant qualified her interest in this type of career: “I would only like to be a small animal vet as I find cows, sheep, goats and horses scary (their eyes freak me out)”.

One boy wanted to be a physicist “because it is more practical and interesting. I would like to teach people about physics and do experiments that nobody has tried. Also I would like to travel around the world so I can see many places”.

The last of the five who completed this homework task, a girl, wrote about why she would *not* like to be an environmental scientist, one of the jobs highlighted in the careers leaflets. She commented “they do things about the weather and sometimes they can get judged for their incorrect predictions”.

During the group discussion some participants referred to ‘generic’ roles when asked about what types of STEM-related jobs they might want to do e.g. engineer, mechanic, technician, mathematician. Other participants did identify specific roles, reasons why they felt these jobs were important and/or of value to themselves and others.

Participants discussed a number of medical-related careers including doctors, surgeons, nurses, psychologists, physiotherapists and pharmacists/chemists. The reasons given for choosing these careers included statements relating to job satisfaction “to treat children because it would help people” and financial reward “to make new drugs and medicine to earn lots of money”.

Jobs relating to environmental science also featured quite heavily in the discussion including jobs such as weather forecaster, environmentalist and marine biologist. Reasons given for choosing these careers included “they would help endangered marine animals to make a come-back. Also test and look for new species of animal”.

A third grouping of jobs that the participants identified related to the use of technology/engineering in a variety of settings e.g. game-maker, light engineer, pyrotechnics and sound engineer. The careers leaflets that were given to the participants highlighted sound engineering as a physics-related career and, as discussed later in this report, one of the groups decided to focus on this job in the television series they produced.

Three of the participants said that they would like to be lawyer/solicitors, a STEM-related role that is highlighted in the careers leaflets (for an example see: http://www.iop.org/education/teacher/student/publications/file_39502.pdf accessed 11/12/13). None of the participants in previous studies have identified this as a STEM-related career and this may highlight the usefulness of including a wide variety of possible careers in information leaflets for young people.

One final point to note in this section is the identification by two participants of the job of chef as being a STEM-related career. Many television programmes featuring professional chefs highlight the role of scientific techniques in the production of food e.g. Heston Blumenthal as ‘molecular gastronomist’. Although this link was not pursued during this study it may be useful in the future to explore with CYP whether or not they find this representation of science engaging and how it influences their perception of STEM.

Designing a television series

Appendix 1 includes details of the worksheets that the participants were given for guidance on how to complete this activity.

STAGE 1: Overview of the series

Table 2 below provides an outline of the series chosen by each of the groups.

| Group | Title of series | Genre |
|---------------------------|-------------------------|-------------------------|
| BERCS | Never trust a brownie | Cartoon drama |
| Table turning productions | Meteor contagion | Sci-fi drama |
| PBMC | Sound engineers on tour | Docu-drama |
| No name productions | Aliens vs Chuck Norris | Sci-fi action adventure |
| POF productions | Pass or Fail | Game show |

Table 2: Outline of TV series by group

Each group was asked to produce a visual representation of the series that they could use to outline their series to the whole group.

Never trust a brownie

The cartoon/drama series is based around the character of Ivy, an 'evil teacher' who, because she hates children, makes 'poisoned brownies' which she gives to the children to turn them into adults. Two children are absent from her class on that day and one child does not like brownies and so refuses to eat one. These three children then have to work out how to save the other children and convince other adults that the teacher is not all that she seems to be. This group had not considered some of the aspects of the programme included in the brief, for example which television channel might show a programme like this and what age group their programme was aimed at.

Meteor contagion

This sci-fi/disaster movie is based around what happens when a meteor carrying a virus hits the Earth. The main characters are the scientists who are called in to save the Earth's population. This series was aimed at children 11 years old upwards.

Sound engineers on tour

This docu-drama series is based around a group of sound engineers who are on tour with a Rhythm and Blues band. The mix of genres was chosen to as a way of including both a narrative that young people would find interesting (drama) and STEM content that would be informative (documentary). The series was aimed at young people who were the same age as the participants. The group felt that Sky1 would be the channel that would be most interested in broadcasting this series.

Aliens versus Chuck Norris

This sci-fi action adventure series focused on established characters from existing films³. The group planned to highlight the role of STEM in relation to the weapons used in the battles between the main characters. The group thought that BBC3 would be the channel most interested in broadcasting this series. The series was aimed and young people aged 15 and upwards, and during their presentation the group made the point that the series would have to be shown after the 21:00 'watershed'.

Pass or fail

This game show involved teams of young people answering STEM-based questions in a series of 'knock-out' rounds. The group felt that the channel most interested in broadcasting this series would be ITV1.

³ For further details of the Aliens films see [http://en.wikipedia.org/wiki/Alien_\(film_series\)](http://en.wikipedia.org/wiki/Alien_(film_series)). For further details of the actor Chuck Norris see http://en.wikipedia.org/wiki/Chuck_Norris.

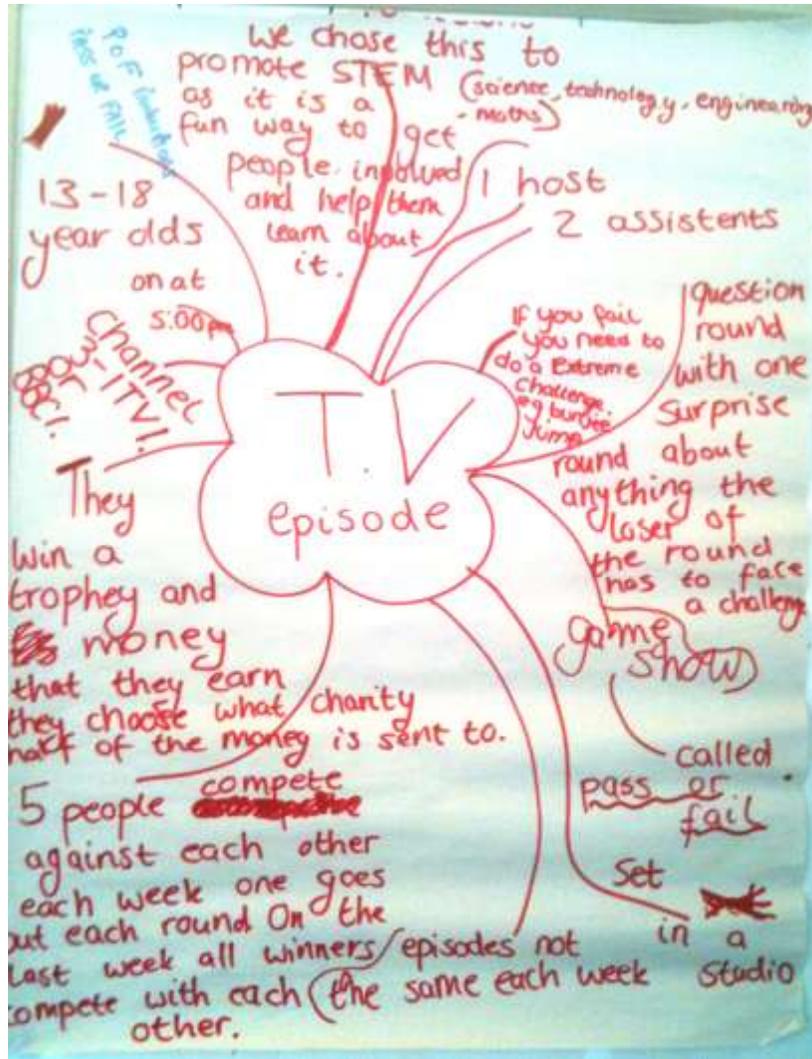


Figure 1: Overview of the series produced by POF productions

STAGE 2: Sample Episode

Never trust a brownie

During this first episode we are introduced to the key characters (Willow, Ivy, Jamie and Chris) and the setting for the series, a school in Browntown. Willow is the school pupil, Ivy is the new teacher at her school and Jamie and Chris are the twins who were absent from school on the day that Ivy brought the brownies. Browntown is so named because everything in the town is brown apart from Willow's 'flowing green hair'. Ivy has 'a very dark secret' and the audience are encouraged to go to the website to find out what this secret is.

Ivy has made some brownies to celebrate Willow's birthday and brought them to school for the children to eat. The participants drew on several technical and plot conventions at this point. For example, as the first child bites into a brownie Ivy turns to the camera and looks 'evily', at which point a flashback is used to show Ivy making the brownies and adding the chemicals to the mixture.

Willow, Jamie and Chris all arrive at the school the next day to find that they are the only children there. After school they all go around to another friend's house to find out why she was not at school, but the friend's parents will not let the children in and they seem to be behaving suspiciously.

The participants again draw on conventions at the end of this episode when the three children look at each other "as to think something strange is going on" and the camera pans across the children's faces. They ended both their presentation to the class and their storyboard with "dun, dun, dun" to indicate suspense - a 'cliffhanger'.

All members of this group participated in the presentation.

Meteor contagion

This first episode provides the background to the event that requires the intervention by a group of scientists from the UK. The rest of the series will focus on how the scientists go about finding a solution.

The episode opens with a meteor hitting the earth, specifically China. The meteor is emitting a green mist and a high frequency sound, which renders anyone getting too close to the meteor unconscious. Once they regain consciousness the victims are suffering from a virus that causes them to 'de-evolve' into apes.

Although we are not given an explanation of what has caused the meteor to impact on the Earth, when the group 'acted out' elements of this first episode there did seem to be some suggestion that the impact was not accidental, with one of the participants

appearing to 'launch' the meteor, laughing in such a way as to mimic a stereotypical 'evil scientist' character.

Of the seven members of the group, only five (all boys) are involved in the presentation. Throughout the presentation the remaining two members (one boy and one girl) remained out of view, standing either behind the flipchart holder or the book shelves.

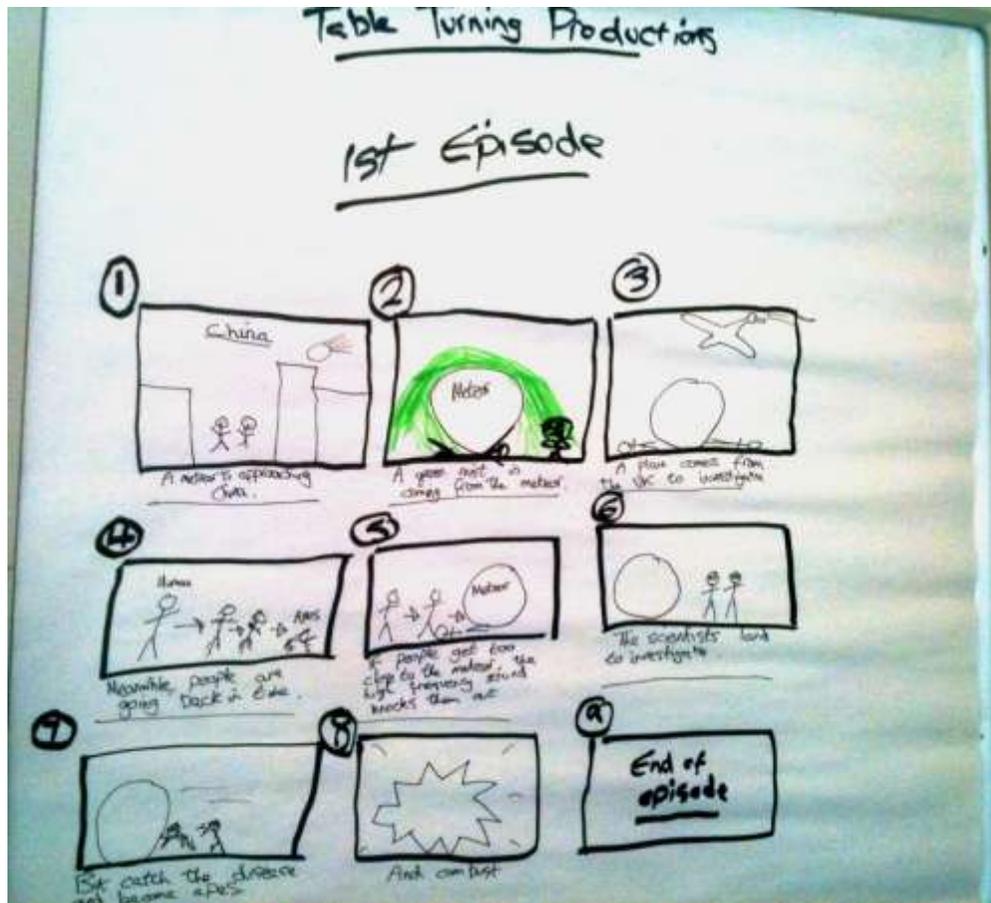


Figure 2: Storyboard for Meteor Contagion

Sound engineers on tour

In the first episode of this docu-drama the three main characters (all male) are hired to work as sound engineers. We are not given any further details about these characters other than their gender and that they are 20 years old. We are told that the R&B band are famous, but no further details are given. The problem that the engineers have to

tackle in this first episode is that during a rehearsal the speakers 'pop' and stop working. We are told that the engineers mend the speakers, but no further details are given.

Only three members (all male) of this group presented the group's ideas, with the three other members (two female, one male) not participating. At one point one of the presenters has to consult with a female member of the group as she appears to have written at least some of the notes for the presentation, and he cannot read her writing.

Aliens versus Chuck Norris

All members of this group (all male) took part in the presentation. The presentation consisted solely of the group 'acting out' this episode, with no accompanying presentation or storyboard. The participants appeared to be simulating fights between various characters, but much of the presentation took place behind the book-shelves and, as such, out of view of everyone else.

Pass or fail

Despite producing a very detailed storyboard for an episode of this game show (see Figure 3 below) this all-girl group were reluctant to present their ideas to the larger group. As a result the main points of the episode are only presented in response to a series of questions from a member of the research team. Only three members of the group respond to the questions.

The format for the show involves contestants answering STEM-based questions. If the contestants answer incorrectly they have to undertake forfeits. Each forfeit is relevant to the specific STEM area of the question e.g. the science forfeit involves the contestants having to hold spiders and have a snake around neck, the 'M' forfeit involves the contestants having their hair shaved into the shape of a number. The contestant that answers the most questions correctly wins a cash prize, but they must donate half of the money they have won to a charity of their choice.



Figure 3: Storyboard for Pass or Fail

STAGE 3: Websites and merchandising

All of the groups demonstrated a good understanding of the content that programme-related website might contain. All groups included some level of interactive content, including links to social networking tools such as Facebook and Twitter (see Figure 4 below), and the potential offered by cross-platform activities e.g. mobile apps, games produced for hardware such as Microsoft X-Box.

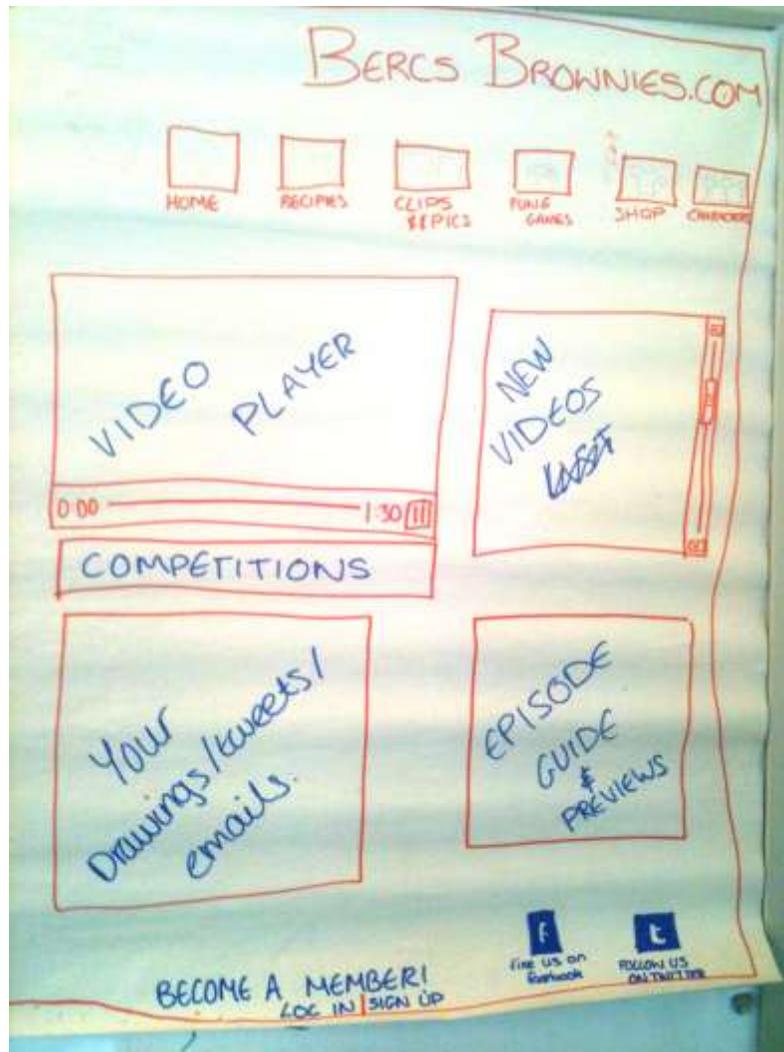


Figure 4: Website designed by BERCS

In contrast to our previous study, however, none of the groups used the websites to promote the educational aspect of their programmes or explicitly recognised the potential for programme-related websites to be used as a way of engaging the audience in STEM-related activities.

Writing a letter of recommendation

Table 3 below shows the number of recommendations each proposed series received.

| Series | |
|----------------------------------------------|----|
| Never trust a brownie - BERCS | 10 |
| Meteor contagion - Table turning productions | 7 |
| Sound engineers on tour - PBMC | 6 |
| Aliens vs Chuck Norris - No name productions | 5 |
| Pass or Fail - POF productions | 1 |

Table3: Recommendations for each proposed series

Nearly all of the participants identified the relevant STEM content in the programmes. Some highlighted the importance of using traditional settings for STEM e.g. “good at introducing STEM because they were in a school and in school you do science, technology and mathematics” whilst others felt it was important that the STEM content was represented outside of these contexts e.g. “it shows aspects of Engineering and Science in a natural environment and shows that science is not just in labs” and “This would appeal to young people as it is about a R&B tour”.

As with previous studies carried out by the IW team, the participants commented on the importance of the STEM content enabling something to be learnt e.g. “it prompted science through sci fi comedy which contained factual information about science, maths, engineering and technology”. Alongside this need to be informative, the participants emphasised the role of humour in engaging the interest of CYP and the need for programmes to be exciting:

- It's unique and the creativeness makes it sound exciting.
- It is a funny show that interested me when it was presented.
- I think that this series will be appealing to young children because they like new things and very rarely get a horror cartoon so the children will be more interested in this.
- This series will be appealing to children because it involves killing and dark humour.

- It interests people in science in an exciting action-packed way
- You should choose [it] as it's funny and exciting.
- It is appropriate for the audience they chose because it is funny but also informative
- Also it is very exciting as it is full of action

In their responses participants also showed quite sophisticated media literacy skills in terms of demonstrating their ability to conceptualise an audience, and what sort of programming is suitable for that audience, and understand devices used in programme-making such as the role of genre and narrative:

- I also found its plot easy to follow and I think that children, who were our target audience will also find the plot easy to follow.
- It appeals to children because it includes comedy appropriate for that age.
- It has a good storyline that you could build on and continue.
- Never trust a brownie again on BERCS should win as it had a continuous storyline it has been well-thought through.
- I believe that this series will go the furthest because you can create so many different ideas because you have left a cliffhanger anything can happen.
- It had a very easy plot to follow and appeals to children.
- It will appeal to children because it features pop bands which appeal to children as lots of teenagers like music.
- It was a mixture of all the genres and would be a huge hit to all sorts of kids.
- It would be fantastic if they turned it into a season, and it would be good to turn into a film in the future.

Summary and recommendations

Despite the constraints in delivering these activities that we note above, we believe that there are insights offered by this study that could prove useful in relation to the aims of the RAP project and IOP's engagement with young people more generally.

Supporting the development of communication skills

One of the key issues raised by Search (2012) in her review of current literature relating to the RAP project was the need to support the development of presentation skills in preparation for pupils applying for higher education.

We would argue that activities that not only encourage the engagement with STEM-related topics but that draw on media literacy skills can prove more effective in this regard than more 'traditional' presentations that might form part of established curriculum delivery.

Where lack of self-concept in relation to STEM topics in particular, and lack of confidence more generally, might be an issue, activities that draw on already established skills have the potential to provide a more positive learning experience for pupils. Additionally, game-based learning and the use of simulations in the classroom promotes experiential learning, which in turn helps learners make connections between specific learning contexts, like school, to their experiences in the wider world (Whitton and Moseley, 2012)

As outlined above, whilst the participants were able to work well in small groups and demonstrated a good understanding of the potential for STEM-related content to be integrated into programmes that young people would find engaging, attempts to encourage the participants to communicate their ideas to the group as a whole did highlight that these types of communication skills were less well-developed.

It is understandable that young people of this age may well feel self-conscious when attempting to present their ideas to both their peer group and to research team members, who they had not met previously. More exposure to activities that support the development of these communication skills, however, should support young people in overcoming this self-consciousness and develop their confidence.

Young people constructing role models

Search (2012) also highlights the importance of exposing to pupils to positive role models. Whilst it is important that young people meet and engage with 'real life' role models, the positive impact of fictional characters that young people can identify with should not be underestimated. As Search comments 'being from an under-represented group means that there will be a lack of role models for youngsters to aspire to who are "like them"' (p.27).

Media representations of fictional characters can, at least in part, help address this lack of role models (O'Keefe, 2013). Specifically engaging young people in analysing the ways in which these representations are constructed can help them question the assumption that science 'is not for me'. Negative stereotypes are present in popular media, and young people need the skills and confidence to deconstruct these representations and imagine themselves in a positive role.

It is important, however, that young people do not feel that these fictional role models are imposed on them by adults. As already discussed, whilst adults may feel that it would be beneficial to re-shape or subvert representations of characters, young people may not react in the way that adults assume they might. For example, representations of 'nerds' and 'geeks' are not always viewed as negative by young people, and can sometimes be viewed as a positive engagement with emergent youth sub-cultures (McArthur, 2009).

We would argue that any initiative that focuses on role models, whether real or fictional, should take as its starting point the involvement of young people in discussions about what a 'positive role model' might /represent for them.

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Appendix 1: Details of activities

DAY ONE

| Activity | Instructions and illustrations |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Identifying TV programmes and films</p> <ul style="list-style-type: none"> • Newsround • Pet squad • Live and deadly • Blue Peter • Bang goes the theory • Blast lab • Sarah Jane adventures • Scooby doo • The Muppets | <p>Example of worksheet</p> <div style="display: flex; align-items: center; justify-content: center;">  <div style="margin-left: 20px;"> <p>Do you recognise the programme?</p> <p>YES NO</p> <p>In your group, discuss whether this programme includes science, engineering or mathematics in any way. Make some notes on your discussion in the box below.</p> <div style="border: 1px solid black; height: 100px; width: 100%; margin-top: 10px;"></div> </div> </div> |
| <p>Identifying characters</p> <ul style="list-style-type: none"> • Lisa Simpson (The Simpsons) • Helen Skelton and Barney Harwood (Blue Peter) • Ricky Boleto and Hayley Cutts | <p>Example of worksheet</p> |

(Newsround)

- Dodge the beagle, Sheeba the tabby cat and Bingo the guinea pig (Pet Squad)
- Rani Price and Johny Pitts (Roar)
- Yan Wong and Liz Bonin (Bang goes the theory)

Who is this character? _____ Are they male or female? _____

How old are they? _____

What sort of personality does this character have?



Do they talk about science, engineering or mathematics? If you think they do, what sort of things do they talk about?

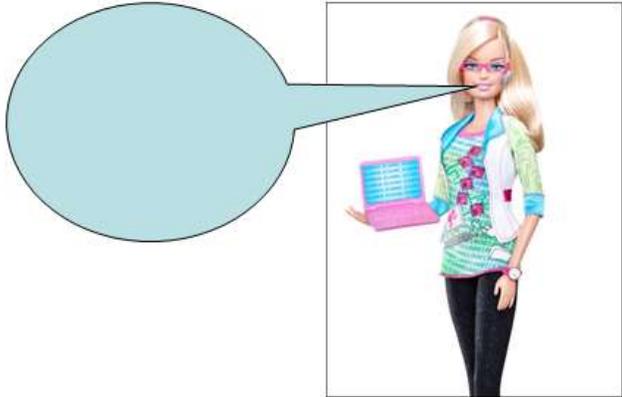
Identifying episodes or scenes

- Fleabag monkeyface
- The Simpsons
- Pirates, an adventure with scientists
- Spiderman

Example of worksheet

Have you seen this film? Do you remember this scene? If you remember this scene, what was it about?



| | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>What might the characters be saying?</p> <ul style="list-style-type: none"> • Computer engineer Barbie • Charles Darwin (Pirates, an adventure with scientists) • Professor Eureka (Pet squad) • Velma Dinkley (Scooby Doo) • Dr. Dirk Spamflex (Fleabag monkeyface) | <p>Example of worksheet</p> <p>What might these characters be saying about science, engineering or mathematics?</p>  |
| <p>Viewing extracts</p> <ul style="list-style-type: none"> • The Big Bang Theory • Spiderman • Pirates, an adventure with scientists • Fleabag monkeyface • Dr Who • Newsround | <p>Worksheet instructions</p> <p>For this activity you will be watching a short extract from a television programme or film. You will need to take notes whilst you watch the extract. Read through the activities below so that you know the kinds of topics you will be discussing..</p> <p><u>Describing</u></p> <p>1. Write a short narrative describing what happens in the extract you have watched.</p> <p>You might like to think about the descriptions you have read in television listings magazines that inform the viewer what a particular programme is about.</p> <p><u>Analysing</u></p> <p>2. Do you think that this programme would appeal to people of your age group? Why?</p> <p>If you do think that the programme would appeal to young people, try to write down at least three different reasons. You might like to think about issues like storylines; what type of programme the extract is from; the characters in the extract; or things like music and special effects.</p> |

| | |
|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>3. Have the programme-makers used any stereotypical images of STEM or STEM professionals in the extract? Try to write down your reasons for identifying these images as 'stereotypical'.</p> <p>4. Have the programme-makers used any stereotypical images of men or women in the extract? Who do you think these Try to write down your reasons for identifying these images as 'stereotypical'.</p> <p><i>You will use your analysis to talk to the rest of the group about the extract you have watched.</i></p> |
| Facilitated discussion | Whole class discussion of the extracts and of stereotypes and how and why they are used in film and TV, linking back to activities above. |

HOMEWORK

| Activity | Instructions |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reflective writing | <p>Students were asked to imagine and write a short account (no more than 1 side of A4) of themselves working in STEM/physics when they are grown up. What would they be doing? What would their salary be? Where would they be working? How would they feel about it?</p> <p>Students were directed to IOP Careers material (downloaded from the web) as a stimulus for this activity.</p> |

DAY TWO

| Activity | Instructions |
|---------------------------------------------|---------------------|
| Developing a television series about | Scenario |

| | |
|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>STEM</p> | <p>The legendary television producer, Ms Big Bucks, has decided that she wants to make a television series that promotes science, technology, engineering and mathematics (STEM) to young audiences.</p> <p>Your group own and run a television production company. Your company have been given the opportunity to 'pitch' your ideas for such a television series to her.</p> <p>Working in your groups you need to follow the brief provided for you below by Ms Big Bucks' television production company. The brief outlines the different stages of the bidding process. After you have completed each stage of the project, you will present your ideas to the Executive Board of the television company.</p> <p>The other members of all the other groups will be acting as the Executive board during your presentation, and you will play the same role when other groups give their presentations.</p> <p>At the end of the whole process you will be asked to write a recommendation to Ms Big Bucks, suggesting which programme she should fund and why. So remember to take notes during the presentations!</p> <p>Your first task is to think of a name for your production company, and then start work on Stage 1 of the pitch.</p> |
| <p>Stage 1: Overview of the series</p> | <p>You need to produce a general overview of the series you are proposing. You might like to consider some of the issues below.</p> <ul style="list-style-type: none"> • What type of programme series are you producing? Choose from: cartoon; natural history; news and current affairs; schools/learning programme; comedy; drama, reality television, game show, soap opera, documentary. • What is your series about? |

| | |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <p>Imagine that you have to make a series of six programmes. Try thinking about what the series will involve. For example, if it is a quiz show, will it be the same format each week? If it is a drama, how will the plot develop? If it is a news or current affairs programme, will you have special reports on topics? What sorts of topics might they be?</p> <ul style="list-style-type: none"> • What are your reasons for choosing this type of programme for promoting STEM? • How will you make sure that it appeals to children and young people? • Are there examples of programmes on television that have influenced your choice? If so, what are they? What is it about these programmes that you like? • What will your programme be called? • Which television channels do you hope will want to buy your series? Why did you choose these television channels? |
| <p>Stage 2: Sample episode</p> | <p>For this activity you need to choose one episode of your series and think about it in more detail.</p> <p>Remember that Ms Big Bucks wants to fund programmes that promote science, technology, engineering and mathematics – so remember to emphasise how your episode would achieve this.</p> <p>You also need to think about what characters/presenters might be in this episode. Make a list of the names of any presenters or characters that you would like to include and the roles they are playing in your programme.</p> <ul style="list-style-type: none"> • How old are they? • Are they are male or female? • What will they wear? • What kind of personalities do they have? • What do they do in this episode? |

| | |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <ul style="list-style-type: none"> • Are there any ‘real’ people in this episode? For example, will you use presenters that already work on television programmes? Sometimes people make ‘guest appearances’ on television series – will you have any guests appearing in this episode? <p>Once you have discussed these points, decide how you are going to present your ideas to the Executive Board</p> <ul style="list-style-type: none"> • It would be useful to produce a ‘story-board’ for this episode that you can use in your presentation. • It might be useful for a different member of the group to talk about each of the characters/presenters. You could choose to ‘act out’ the characters/presenters rather than just talk about them! • Use the flip chart paper and pens to help present your ideas. • Make notes for each presenter. • Remember you are trying to sell your ideas to the Executive Board – so try and make your presentation lively and interesting! |
| <p>Stage 3: Websites and merchandising</p> | <p>Many television series now have websites that contain more details about the programme and its characters. The websites also often include interactive games, short clips from the series or pictures and music that viewers can download.</p> <ul style="list-style-type: none"> • Will your series have a website? • If so, what sorts of things will be included on your website. • If not, why have you chosen not to have a website? <p>Many television series now have additional ‘merchandising’ – products that help promote the television series. These might include doll or action figures, board games, comics or books, lego models or clothing.</p> <ul style="list-style-type: none"> • Will your series have this kind of merchandising? • If so, think of three items that you think will be ‘best-sellers’. • If not, why have you chosen not to have this kind of merchandising? |

Reflective writing: making your recommendation

For this activity you need to imagine that you are a member of the Executive Board of Ms Big Bucks television programme. Which series are you going to recommend Ms Big Bucks invests here money in? **Note: you may not choose the series that you helped to design.**

Write a letter to Ms Big Bucks outlining your recommendation. Some points you might like to consider are:

- Why do you think this series will be successful in promoting STEM?
- Why do you think this series will appeal to children and young people?

Appendix 2: Television programmes or films that the participants identify as containing representations of STEM

| |
|---------------------------------------------|
| Futurama |
| Jonny Tec |
| Countdown |
| Embarrassing Bodies |
| Friends - one character is a paleontologist |
| CSI |
| Scrubs |
| Extreme makeover |
| Robot Wars |
| Vampire Diaries |
| Sky Sports News – analysis after the game. |
| Big Brother - psychology identified as STEM |
| Top Gear |
| Lost |
| Harry Potter |
| Hunger Games |
| NCIS |
| The Host |
| I am number 4 |
| Power of 6 |
| Planet Earth |
| Spring Watch |
| Autumn Watch |
| New Moon |
| Eclipse |
| Breaking Dawn |

Centre for Research in Education
and Educational Technology
The Open University
Walton Hall
Milton Keynes
MK7 6AA

Elizabeth Whitelegg
Email: liz.whitelegg@open.ac.uk
Tel: +44 (0)1908 654611

Dr Richard Holliman
Email: richard.holliman@open.ac.uk
Tel: +44 (0)1908 654646