

Spooks and Spies

Final Report

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Science made simple

**Cardiff University
Innovation and Engagement Fund
Spooks and Spies
Final Report**

Summary

The project involved the development and delivery of an interactive science show for year 7 – 9 pupils (11 – 14 year olds). The show uses demonstrations, multimedia and volunteers to allow the audiences to engage with the show and its material.

Using the popularity of forensic science and investigative tv programmes as a hook, the show explores the science behind a number of crime-solving and spying techniques. Audiences then use this science to solve a crime live.

Overall the project has been a great success. It has met the majority of the objectives, has been very well received, and has interest for the future.

Aims

- To show the relevance of science to everyday life.
- To highlight the variety of careers in science
- To feed science into popular culture.
- To refer to spy tv shows/films the audience may be familiar with to capture their interest, and to enthuse them about science by showing them some of science behind these shows.

Project development

Content

The show uses a strong narrative, demonstrations, volunteers and video clips to illustrate the key points of the show and to allow the audience to engage with the performance.

At the start of the show the audience are told there has been a burglary at the science made simple office and that they must use different crime-solving techniques to find evidence.

Led by the presenter, the audience learn about these techniques, and use them to gather clues leading to the identification of the perpetrator of the crime.

At the end of each section, any pieces of evidence that have been collected are recorded on a crime board. As the show develops, the crime board fills up with clues and by reviewing the clues it becomes apparent that the culprit may indeed be in the room! This narrative along with the repeated reference to the crime board is use to build momentum and drive the show to its conclusion.

Throughout the show students are encouraged to share their ideas and opinions on the technologies being explored.

The show focuses on the following key areas:

- CCTV - where you find it, hidden cameras, ethics of CCTV and current developments such as face recognition technology.
- The use of UV light to make hidden traces of evidence visible.
- DNA as evidence and the social implications of a DNA database.
- Message self-destruct – chemical reaction to show how a message can self-destruct.
- Infra-red (IR) light – principles of IR light, and the use of IR to reveal hidden evidence through heat imagery.
- Key skimming technology – to show implications of this kind of technology.
- Identification of fingerprint types, and how fingerprinting works.
- GPS tracking – through smart phones
- Codes – basics of ciphers and coding

Development

Initial development began with an in-house meeting to exchange ideas. In this session any topics related to the title or the aims of the project were considered. Many different show styles were also considered at this time.

These were narrowed down to a few show styles, and a suitable collection of demonstrations was considered for each. Some initial background research was done

to investigate the scope of these demonstrations and whether the surrounding science would be interesting and relevant.

We researched old-fashioned, current and cutting-edge spy technology. Seeking inspiration from James Bond, CSI and other such programs from within popular culture, the show aimed to explain some of the science behind programs the audience would have seen on TV. These shows were used as a 'hook' to capture the audience's interest. We aimed to develop this interest further by using exciting, interactive science demonstrations to further their understanding and in doing so build their enthusiasm for science.

The initial ideas, and show formats were tested and explored by on a focus group at Croesyceiliog School.

The most popular demonstrations and show format were then put together, props sourced, and more research carried out to build each section of the show.

The completed show was piloted in Croesyceiliog School at the end of June 2009.

Feedback from the pilot was mixed, with strong support for the demonstrations but a feeling that the format was in need of some revision. Changes were made in light of this and a second pilot show in November 2009 was met with greater approval.

Recruitment and delivery

A first tour was planned for the end of November 2009 with the remaining shows to take place in the summer term. Some problems with marketing and clashes with exam periods meant that the majority of shows were performed in June 2010

The show was delivered to 10 schools in total, including the second pilot. All schools were within 100 miles of Cardiff, mainly in South East Wales, and South West England.

To find schools we used our contacts in Careers Wales, local STEMNET contacts, Glamorgan Education and Business Partnership and schools we had been to previously.

Schools were offered the show at a reduced cost allowed us to work with groups we would not otherwise reach. The remainder of the normal costs were subsidised by a grant from Cardiff University.

15 shows were delivered over 10 venues, names of schools, and the numbers of pupils reached in each can be found in the table below.

The shows were 55 minutes long, but were adapted to fit the lesson period lengths where necessary.

The shows were delivered by two of science made simple's experienced presenters, Becky Davies and Helen Lloyd.

PILOT - St Cenydd School, Caerphilly	150
Hereford Home Education Group, Hereford	15
New Leaf Home School Group, Newtown, Powys	40
Whitecross School, Lydney, Gloucs	160
St Julians School, Newport	140
Whitecross Hereford, High School and Specialist Sports College, Hereford	380
Blessed Edward Oldcorne Catholic College, Worcs	200
Pittville School, Cheltenham	150
Maesteg Comprehensive School, Maesteg, Bridgend	100
Bishop of Llandaff Church in Wales High School, Cardiff	160
Total	1495 total

The developed show was delivered on time, with keen interest from schools for the project to continue. We did not allow enough development time for the conception of the show, and as a result the development of the project used a few more days than originally planned which came out of science made simple's budget.

Evaluation

The shows success was measured against the objectives below. Most of the objectives were met and the project was delivered on time and within budget.

Objectives

The objectives for the project were:

- To show how physics research is applied for modern undercover operations and for National security. The aim is to liaise with relevant industry links (eg QinetiQ) to ensure the show represents the very latest in technologies used by the modern day James Bond!

We were able to include references to cutting edge technology in a few sections. The strongest reference to cutting-edge and developing technology is with face recognition software. The current technology can identify a 2D image of a face if it is front-on to the camera but advances are being made all the time. Reference is made to this software in digital cameras and in passport scanning to show how cutting edge technology has applications in everyday life, and in National security.

Other references to cutting edge technology are GPS enabled smart phones, and key tracker software.

- To deliver 10 shows to local secondary schools

Including the second pilot show, we reached all of the 10 schools successfully with further interest for the future from more schools.

- To reach minority groups and isolated groups such as small rural school, schools in economically deprived areas and adult learning groups, using our contacts at careers Wales and Hands on science.

We reached 2 home education groups of less than 50 pupils each, and 2 schools in South Wales who expressed they would not have been able to afford the experience otherwise.

Impact

The impact on the students was assessed through a short questionnaire (appendix). The questionnaire was produced in line with the Generic Learning Outcomes (GLO) strategy. GLO's were developed by the Museums, Libraries and Archives Council as a way of recording attitudinal and emotional change in informal learning environments. www.inspiringlearningforall.gov.uk/toolstemplates/genericlearning/

The objectives that were measured in this way were:

- **To promote debate about issues of which are of national relevance eg ID cards and personal privacy. We will use our computer voting system to collect opinions.**

The show raises controversial issues of the DNA database, CCTV, and the fingerprint database. Due to the immediacy of raising hands to show opinions, we decided to use a show of hands instead of our computerised voting system. Prior to asking opinions both sides of the argument are presented. Pupils are then asked to vote. The presenter puts their hand up for both opinions to reinforce the idea you can think the ideas are both good and bad. The mini-debate is concluded by saying there is no right or wrong answer to encourage audience members to examine their own opinions. It was clear that pupils understood the issue was difficult and there was no right or wrong answer reflected by some students putting their hands up for both answers and looking to their fellow pupils to see what they were doing. This appeared to be an indication they did not know if they should agree or disagree, and that the issue was complex.

- **To disseminate aspects of research from the School of Physics and Astronomy in a format that is both entertaining and engaging.**

When asked if they had enjoyed the show 83.2% of those asked said they did enjoy it (see fig 1). Additional comments included: "I think it was great – I loved it" This is a clear indication that the majority of the audience enjoyed the experience. After a lengthy developmental process it was decided that the research of Cardiff School of Physics and Astronomy did not fit with the story line of the show, and was not included. However, the show covered aspects of other Physics and therefore the majority of the audience had a positive experience with physics and science.

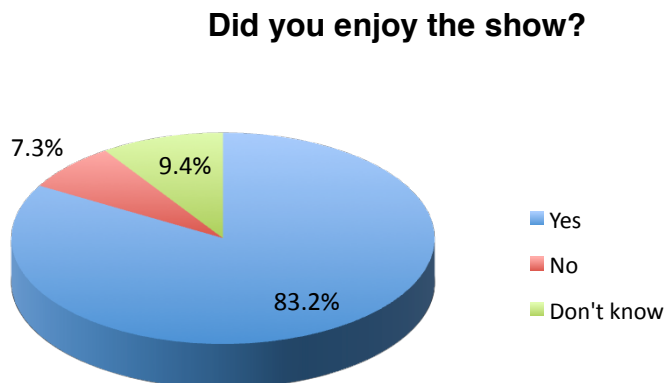


Figure 1. Results of the question 'Did you enjoy the show?'

- To excite and enthuse the next generation of Physicists

When asked if they were more interested or less interested in science as a result of the show, 60% said they are more interested (see fig 2). Whilst this is not the strongest majority, it is a clear indication that more than half of the audience are more interested in science as a result of seeing our show, and went away more interested and enthused.

Has the show changed the way you feel about science, are you more or less interested?

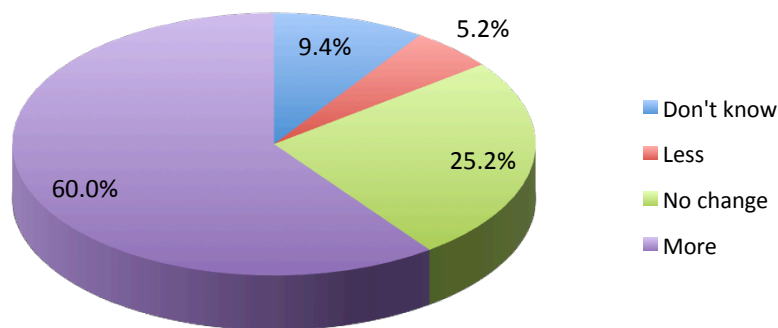


Figure 2. Results of the question ‘Has the show changed the way you feel about science?’.

- To Illustrate the use of science and technology used in covert operations.

On reviewing the questionnaire, 73% indicated that they learnt something from the show, with 54% mentioning directly one of the technologies mentioned in the show. All the technologies in the show were mentioned by at least one audience member.

In response to the question if you learnt something tell us what it was here’ A range of comments included:

“How infrared is used and how they solve crimes using science”

“Lots”

“CCTV, solving crimes with different equipment, UV and infrared, facial recognition through nodes”

“About UV lights, sweat, types of fingertips, saliva, nodal points”

“I learnt how to use infrared and how technology is improving”

“About all the things that include DNA”

“I learnt that things which seemed to have nothing to do with science actually had science in it”

“About the powder to bring up fingerprints”

“I learnt that they can track where you are from your phone”

“How to solve crimes and how the process of crime-solving works”

“Finger printing and CCTV cameras”

“There are three fingertip types you can have”

“That when you are trying to find out who's fingerprints they are, it is not easy”

“Black-light/UV and Codes”

“There is DNA in hair”

“I have learnt about face points, DNA and CCTV”

“Infra-red and UV light”

“That you can use a computer for face identity”

“What you leave behind at a crime scene”

“I learnt how scientists find out interesting things”

Conclusion

Overall the project was a success. It was delivered on time with most objectives fulfilled and received positive feedback from teachers and pupils. Some of the schools also chose to have more than the one show offered at subsidised rate, showing an obvious interest in the subject, and has further interest for the future.

The development process was successful and we have generated a successful show liked by teachers and pupils alike. The show fills a gap in our repertoire, and is a show that presents a mix of Physics, Biology, Chemistry and Maths used in a practical way. Feedback forms given to teachers have indicated how they think shows like this one are great for highlighting careers, and that they think the theme of the show is a great topic.

Some quotes from the forms include:

“A brilliant show that held the attention of the audience throughout”

On asked ‘What kind of topics would you like to see in new science made simple shows?’ One response was “More like this one – how science relates to the real world and different jobs”

Pupils forms were also very positive with 83.2% of those asked said they enjoyed the show. Not only did they enjoy the show but the majority of audience members also learnt something with 73% saying that they were going away having learnt something new. 54% mentioning directly one of the technologies mentioned in the show. All the technologies in the show were mentioned in this box by at least one audience member and with 60% saying they are more interested we can say that they went away enthused.

During the development process we came across a few challenges. One of the aims was to include cutting edge technology and liaise with relevant industry to represent the latest technology that might be used by the modern James Bond.

We did include some cutting edge technology, however it was harder than we had thought to take inspiration from James Bond. It became apparent that some things from the films are fictional items, so would not be relevant, some are weapons, which we did not want to talk about for moral reasons, and some are cars. Whilst cars would have been interesting, after exploring some of the ideas behind the cars used in James Bond we found the ideas did not fit the story line we had created.

Also we came across challenges when considering cutting edge technology from within the schools of Physics. It became apparent that some aspects of cutting edge technology do not lend themselves to good demonstrations, and also would require more money than we had budgeted for to buy props, as simple demonstrations would not have been anywhere near as effective as having the real thing.

One example was looking at T-wave technology, which uses the latest in body scanning. No obvious links to demonstrations, or props, that fitted the story, were found and so it was decided not to include this technology.

Overall lots of ideas were generated but with show length limited, and based on the fact we wanted to choose things that suited audience and format best it was decided a hidden camera, a computer keyboard key tracker and discussion of GPS-enabled smart phones would be included. Whilst no current research from Cardiff University School of Physics and Astronomy was included, other Physics was included. As the results of the questionnaires show that the majority of the audience enjoyed the experience, we can conclude that they had a positive experience with physics and science.

Another challenge in the development of the show was that we over-ran in development days. My feeling is that whilst the initial brainstorm we had was very beneficial, as was the focus group, this initial stage was not as focussed as it needed to be.

During the focus group stage, the pupils seemed to like everything and seemed reluctant to discard anything. I think that had we made the choices more anonymous – perhaps an anonymous ballot to pick a favourite demonstration – their decisions might have been better thought out. Also it may have been more beneficial to take along basic equipment and pilot some demonstrations at a focus group.

As a result of lessons learnt from this project we have adopted some changes in how we will develop future projects. We have since explored other ways to commence the development process and as a result we now come to the initial meeting with an idea of the show, and potential props, and demonstration ideas, rather than generating ideas fresh at the session. We also have a team of at least 2 people to develop a show. This is much more efficient at developing ideas and thus cuts the development time to the 25 we days we originally suggested.

We were pleased that the funding has allowed us reach groups we would not normally work with. Many of these groups can only afford a science made simple show with subsidy funding. Such funding allows more teachers to see the enthusiasm in the students, and therefore stronger support to encourage science departments to spend money on such enrichment activities in the future. It has also allowed us to work with Careers Wales and the EBP further strengthening our relationship with them.

In summary the show was a great success. One of science made simple's aims is to raise interest in science and we certainly feel that the show did that. The project has resulted in an exciting new, topical show, enjoyed by both teachers and pupils, which incorporates cutting edge science, discusses controversial issues, and highlights different science careers. Audience members have enjoyed the show, and have gone away having learnt something.

Now that the funded stage of the show is concluded it will go into our portfolio of shows. *science made simple* reach around 25,000 people each year so we are hoping to reach lots more pupils with show. We are also hoping it will enter the festival circuit. The first submission will be to the Big Bang Science fair, which next year will be in London. All

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shows are re-visited with updates on material every year, so this show will continue to be topical. As we have been able to develop the show so thoroughly it will require minimal time and expenses to keep it current.

Throughout this process we developed the show but we have also learnt about our own development process and strengthened our standing in the community and links with local schools and education professionals.

We are very grateful for this funding opportunity and look forward to reaching many more pupils with our show.

Becky Davies

science made simple

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Appendix

1. science made simple GLO form



What year are you in? (please circle)

Year 7 Year 8 Year 9 Year 10

Year 11 Year 12 Year 13

Are you... male female

1. Did you enjoy the show?

Yes No Don't know

2. Did you learn anything new in the show?

Yes No Don't know

If yes, tell us what it was here:

3. Has watching the show changed how you feel about science and engineering? (please circle one)

Don't know

I am less
interested now

The show didn't
change how I felt

I am more
interested now

4. Would you like to be a scientist or engineer when you are older?

Yes No Don't know

5. Would you like to see another show like this about science or engineering?

Yes No Don't know