

Using Drama to Communicate Science

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Abstract

This paper discusses the effectiveness of using drama as a medium for communicating science.

It details the development of an innovative formula that has proved very successful in bringing together scientists, drama teachers, science teachers and school students who then work together to produce dramatic performance pieces that address a wide range of scientific issues.

A key feature of the initiative is the training/motivating workshop at the start of the project in which a variety of strategies are employed to address the very different needs and expectations of the participants. A game-show format is used as an icebreaker to encourage scientists, teachers and drama professionals to share knowledge and to explore ways in which they might work together. Drama teachers and students are given an insight into the research process and how they might use physical theatre to illustrate scientific principles. Science teachers are introduced to the use of specific dramatic techniques such as Boal's Theatre of the Oppressed to address moral and ethical implications of science. School students are given the opportunity to devise and perform short pieces.

The paper presents an evaluation of the initiative drawing on experiences from scientists, teachers and students who have participated in workshops and performances.

Paper

The effectiveness of using drama as a medium for communicating science
Gillian Pearson and Bridget Holligan, The Oxford Trust

It is not unusual these days for dramatists to tackle scientific issues in their plays. Currently in London's West End there are two such plays attracting full houses and glowing reviews. Caryl Churchill's *A Number* is an exploration of the nature versus nurture debate described by one critic as "an hour long experiment in prediction, a sort of nightmare imagining what the magic of science, in relation to cloning, may one day require of our hearts and minds." In *Life x3* Yasmina Reza uses the idea of parallel universes to play out one scene three times with subtle variations each time and her main character is a cosmologist anxious about the publication of a scientific paper. These plays follow other stage and television productions with science as a central theme such as Stoppard's *Arcadia*, Frayn's *Copenhagen* and Rusbridger's highly controversial TV *Drama Fields of Gold*.

There have also been several UK drama companies who have specialised in Theatre in Science for schools for a number of years. The Molecule Theatre Company performed for over 25 years at the Mermaid Theatre and companies such as Floating Point, Kinetic, Livewire and the Living History of Science have toured schools, science festivals and public venues UK wide.

Floating Point Science Theatre

Floating Point Science Theatre specialised in performances for primary schools. Their one hour plays conveyed science facts in a story e.g. What a Gas has King Plasma searching his kingdom for 'lost' water learning about states of matter as he goes.

At their peak in the mid-nineties Floating Point performed over 800 shows to almost 200000 pupils in primary schools each year.

The shows were well received and attracted critical acclaim from educationalists. The TES reported that "the boundaries between science and art come crashing down during a performance by Floating Point Science Theatre".

The evaluation of the shows focused on teachers. A questionnaire review in 1995 from 524 schools revealed that:

98% thought that their show was either very useful or invaluable 65% said that the show was enjoyed by all of the children all of the time 92% said that their children learned either a lot or a great deal 68% said that they expected their children to approach science and technology with more enthusiasm 84% said they considered Floating Point's follow up work either very useful or a good source of ideas

Theatre of Debate

Y Touring have worked with the 14+ age group and in their Theatre of Debate series, commissioned by The Wellcome Trust, they tackled controversial science topics in hard hitting storylines that teenagers could identify with. Their productions included Pig in The Middle a play about xenotransplantation, The Gift which addressed genetic selection and Learning to Love the Grey which featured cloning. The dramatic performance was followed by a debate in which the audience could question the actors (still in character) and scientists and the students and teachers then had an opportunity to explore the moral and ethical issues further through an education pack written in consultation with scientists, doctors and patients which was also available on a web site.

"Ways of engaging the public in debate on scientific issues, like the applications of genetic technology, are desperately needed. The way not to do it is for the media to provide images of scientists and their creations as monsters. But a highly imaginative theatrical venture by Y Touring theatre company may have found a brilliant solution."

Lewis Wolpert The Independent

An evaluation¹ reported that the trilogy had made "an innovative contribution to the public understanding of science." By May 1998 the three plays had been seen by over 73000 young people, teachers, governors, parents, scientists and the general public UK wide.

The evaluation concluded that:

"Arts projects such as these were seen to be very successful in delivering science education. The drama is a way into a lot of areas and enhances the subject especially for those who are alienated or threatened by science. The Gift successfully contributes to science teaching - its strength is in personalising science rather than delivering biological information."

The participating teachers found that this project had had a very positive impact on the students. The students seemed to have gained more knowledge on genetics than they would have done in more formal straightforward lessons. Changes in the teaching of genetics had occurred at many of the participating schools. Many schools attributed a better understanding between Science and the Arts to The Gift and felt that the play encouraged non science teachers to reconsider their opinions of science.

"Without it the cross curricula work would not have happened. It brought English and science staff together."

Secondary drama teacher

The Oxford Trust Science Drama Workshops

The Oxford Trust is a charitable foundation which works to encourage the study, application and communication of science and technology. We had worked with a number of Theatre in Science

companies with schools and public audiences in Oxfordshire and been impressed with the performances and the positive response from students and teachers.

The performances from Floating Point and Y Touring both involved some sort of audience participation and interaction but in each case the play had been written by the company. The performances were generally booked by science teachers as part of the science curriculum and any follow-up work tended to focus on the specific scientific principles and issues raised in the plays rather than further exploring other science topics through drama.

What we wanted to do was to engage students and teachers more directly in the creation of the drama.

In 1997 we ran our first science drama workshops. We wanted to reach new audiences particularly teenagers aged 14-17 and drama students and teachers. We planned a day that combined workshop and performance elements where the process of creating the dramatic piece was to be the main focus of the day not the performance itself. The involvement of scientists was a key element so that students could ask them questions about the science and engage in conversation about moral and ethical issues.

In the first workshops we selected four science topics that were currently quite high profile in the news: the dangers of vaccination, irradiation of food, genetic selection and BSE. The day began with a warm-up session to relax the students and to encourage them to consider physical theatre as a technique for explaining scientific processes. This drama warm-up was a vital part of the event - it increased the students' enthusiasm and reassured them that the event was a 'drama' activity and not just science.

The science topics were then introduced by science communicators and the students, working in groups of four, brainstormed ideas for a performance piece. As the teams worked on their performances, science and drama specialists offered ideas, information and encouragement. The teams had about three hours to develop their piece and then all teams performed their 5-10 minute plays to an invited audience.

The formula worked well and the drama workshops became an annual feature with the number of participating teams increasing from 8 to 19. Different science topics were explored over the years - PPARC funding one year meant that the performances were based on particle physics, stars and galaxies and the solar system; the involvement of the Environment Agency allowed students to explore issues of water pollution and waste management; one year we allowed students to choose their own science topic which resulted in a number of performances on teenage sex and the dangers of smoking.

A questionnaire evaluation of the workshop run in 1998, the year in which PPARC supported the event, revealed the following: 71% of students gave the event a rating of 4 or 5 (on a scale of 1-5, where 1 was 'poor' and 5 was 'excellent'). 68% of students said they would like to take part in a similar workshop again.

At the workshop students were assisted by a drama practitioner and several research scientists, as well as their drama teacher and science communicators from The Oxford Trust. 68% of students felt that they had enough help from other people. Of those that didn't (19%), the areas of concern were better written information, more help understanding the science and more help to develop dramatic ideas, with a slight emphasis on needing more help with the drama.

The student questionnaires were completed a month after the event and students were also asked to describe the piece that they developed. 39% of students included some scientific information in their description:

We performed a piece on particle physics about quarks. We were a quark family - strange, down and top. Top died and then became a gluon. Then charm came and wanted to join. When top was there she couldn't as only three are allowed. The gluon glued us together.

Our topic was particle physics. It was called Deuteronomy's Dilemma about when an electron splits up a neutron and a proton. This was portrayed as a love story.

Our piece was a 'Ready Steady Cook' show with one contestant making the universe - using the idea that it came from nothing. When heated it exploded. It was quite confusing though, as it was almost as if we were describing the big bang that scientists think will end the universe.

Our piece, 'Planets Play Poker', was a mythological-style idea exploring the reasons for the position of the planets and their sizes.

68% of students made suggestions for other science topics that they would like to work on as a drama. There was a wide variety of ideas, with the most popular suggestions being electricity, health issues (e.g. cancer, AIDS, smoking), biology, mixing chemicals, photosynthesis, magnetism and cloning.

There were a number of suggestions for improvement – the most popular comments being to have better props available, to have more help with the drama and not to include a tour of the research facility (the event was held at the Rutherford Appleton Laboratory near Didcot). Other suggestions focused on practical housekeeping matters such as food and fresh air, to train scientists to be less restricting and to include more drama 'games'. Only one student criticised the role of the scientists – ...he kept on trying to push us into things that would not have looked good in our play – things that were far too complicated for drama. We needed simple ideas. One or two others commented on how useful it had been to have real scientists around to give advice.

Science Centrestage

In July 2001 we successfully tendered to The Wellcome Trust to run a National Festival of science drama on their behalf.²

The aim of the project was:

to involve a wide range of young people, including those not necessarily very interested in science, in challenging debates about the social and ethical issues raised by developments, past, present and future in biomedical research, specifically genetics and/or brain science, through a series of regional and national high profile science drama festivals.

The proposed structure was for there to be ten one day autumn workshops designed to enthuse all the participants and to give them ideas to build on. These were to involve teachers, pupils, actor teachers from local theatre companies, playwrights, drama facilitators, PhD students and research scientists.

The workshops would be followed by a three month period of performance development in schools when they would devise their own 20-30 minute theatre pieces with continued support from scientists and drama professionals. Ten regional festivals would then be held around the UK in March where schools would perform their work to an invited audience of friends, family, the local community and people working in the fields of dram, science and education.

We used our experience of running the drama days in Oxfordshire to devise the training/motivating workshops which would be crucial to the success of the project.

We decided to employ a variety of strategies to address the very different needs and expectations of the participants.

- A game-show format was used as an icebreaker to encourage scientists, teachers and drama professionals to share knowledge and to explore ways in which they might work together.
- Drama teachers and students were given an insight into the research process and how they might use physical theatre to illustrate scientific principles.
- Science teachers were introduced to the use of specific dramatic techniques such as Boal's Theatre of the Oppressed to address moral and ethical implications of science.
- School students were given the opportunity to explore biomedical science topics and to devise and perform short pieces.

Drama techniques used to introduce moral and ethical aspects of biomedical science

The feedback from participants indicated that these sessions were extremely useful and stimulating.

For me the discussion/improvisation groups were the highlight of the day. I was most impressed by the ideas that came out of the session. It certainly set me thinking. Contrary to popular opinion, the teachers weren't domineering in this situation and kept quite quiet, giving the kids the chance to have their say and only putting our thoughts in when the kids dried up - which wasn't often!
Secondary drama teacher

A number of different techniques were employed.

Forum Theatre-Style Improvisation

The audience watches a performance improvised around a dilemma. Each character has a given position in the dilemma. He or she puts forward his or her point-of-view during the debate and tries to convince the others of this point-of-view (some bullet points for each character may be useful for this).

At any time a member of the audience, using the 'facilitator', can stop the improvisation. They can either offer alternative strategies for one of the characters or, if they think that character should have said or done something different, they can change places with the actor and act that part out themselves.

Any member of the audience, using the 'facilitator', can stop the proceedings at any time and can discuss, criticise or replace any of the characters.

In addition, these sessions can be extended with:

Hot Seating: Each character sits on a chair in front of the audience and maintains their position and character. The rest of the audience asks the character questions, debates with and challenges that person about their position.

Devil and Angel: One of the main characters with the moral dilemma is given two advisors to sit on his or her shoulders (metaphorically speaking). One is an 'angel' who argues for one point of view, the other is the 'devil' who offers a different point of view. In the theatrical performance, only the character can hear their angel and devil.

Mantle of the Expert: taking on the role of an expert e.g. doctor, scientist

Image Theatre: creating a static ('frozen') image to represent a situation

This technique was used in a session exploring The Impact of Genetic Testing for Cystic Fibrosis.

Cards were given out that described a dilemma for two characters, Carlos and Mollie. After the groups had read the card a game was played with blue and green cards to break the ice and to improve understanding of how Cystic Fibrosis (CF) is inherited. This game was a good way of illustrating that although the probability of having a child with CF is 1:4 each time around, this does not automatically mean that if a couple have four children only one will have the condition.

Carlos and Mollie

Carlos and Mollie want to have children. However, they haven't tried to start a family yet because they disagree on something important. Carlos wants Mollie to get tested for cystic fibrosis (CF). Mollie doesn't want to do it.

People with CF have mutations in one or more genes. These mutated genes give faulty instructions for the production of proteins that help move salt in the body. One result is that the lungs become clogged with mucus, making it hard to breathe. Another result is that the body has a hard time digesting food. The disease can be painful and lead to an early death.

Carlos had a brother with CF. He hated seeing his brother suffer so much. His parents struggled with the hardship and expense of caring for a sick child who never made it to adulthood. Carlos doesn't want to repeat that experience in his own life. That's why he had himself tested for CF. Unfortunately he found that he is a carrier.

CF is a recessive disorder. That means his children will only have the disease if they inherit the mutated gene from both parents. Mollie can get tested to see if she carries the CF mutation. If she does they can have the foetus tested to make sure it does not have two CF genes and is therefore free of the disease.

Mollie would prefer simply not knowing what the risks are. She figures that once a baby is in their arms, they will be glad they had it no matter what.

How can they resolve this?

For the role play the group was split into pairs and each pair had to improvise a conversation between Carlos and Mollie, imagining that this was the first time they had talked about it. Pairs were chosen to share what they had done and their work was used to initiate discussions with the group.

For a further role play four other characters were introduced.

Robert [Carlos's Father]

"Having Francis [Carlos's brother] completely changed my family. I think that in the end the situation was responsible for the break up of my marriage. I still feel guilty that I could never give Carlos or his sister as much attention as they deserved. I hate to say it but if I could turn the clock back I might have chosen not to have him."

Theresa [Mollie's Mother]

"I do not believe in abortion – any life is precious. Anyway perhaps scientists will come up with a cure in the next ten years."

Maria [Carlos's sister]

"I am also a carrier, but my husband and I decided to take the risk which is still quite small. We've now got three healthy children."

Laura [Friend of Carlos]

"I had an abortion for different reasons a number of years ago. I want Carlos and Mollie to know how this has affected me since."

The group was encouraged to split into different pairs and the following suggestions were given for other situations to improvise:

1. Try being Theresa and Robert. Imagine it is a few weeks later. They have gone round to Carlos and Mollie for a meal where the subject has been avoided. Theresa and Robert offer to wash up - how does the conversation develop?
2. Choose either Carlos or Mollie to meet Maria or Laura. Think of where they will meet. How does the subject come up?

As before, pairs were chosen to share what they had done and their work was used to initiate discussions with the group. Overall this session aimed to: Look at some techniques that could be used when developing a performance Look at the issue of genetic testing and the difficult decisions that people have to make Explore how those directly and indirectly involved in the decision might feel

Balloon Debate

Four or five people try to justify why they should not be thrown out of a balloon. Each character starts with a speech justifying their position. The remaining audience vote and the character with the lowest vote exits. Further debate takes place between the remaining passengers and the audience vote again and another is voted out (and so on). The last remaining passenger in the balloon survives because they had the most persuasive argument.

This was adapted for a session on Genetic Engineering and given a topical twist by substituting the Big Brother House for the balloon.

Cards were given out to small (3-4) mixed groups of students, teachers and research scientists. Each group discussed the GM technology on their card – the benefits and dangers and their own personal opinions. Then each group was asked to choose a 'spokesperson' from their group who would speak in favour of the technology on their card (regardless of their own personal feelings). Each group then helped to prepare their spokesperson who 'entered' the Big Brother House.

After the spokesperson from each group had talked briefly in favour of the technology on their card the group as a whole voted out, 'Big Brother' style, each technology one by one – the least acceptable first and the most acceptable last. Everyone could join in with the vote, and each vote was accompanied by a group discussion (led by a facilitator).

By the end of the session you could see which genetic engineering technologies the group as a whole found to be most acceptable and which they found to be least acceptable.

Lines of Agreement

An imaginary straight line is drawn with defined ends. It represents a continuum of the degree that each individual agrees or disagrees with a given statement. One end of the line represents 100% agreement and the other end of the line represents 100% disagreement.

The facilitator makes various contentious statements (ideally clearly phrased so that there is no ambiguity, qualifications or conditions). Each person has to decide exactly where he or she stands along that line.

There will be times when someone else is standing exactly where they want to stand. As with psychometric testing, they must then decide whether they would choose to stand closer to the 'agree' or 'disagree' side.

Before making the next statement, the facilitator may ask for reasons why people took those positions.

This technique was used in a number of the sessions:

Impact of Genetic Testing

I love watching Eastenders.

I agree with a woman's right to abortion under any circumstances. Advances in medicine will cure inherited conditions in the next 50 years. No-one has the right to know details of your genetic make-up against your wishes. [Follow-up: Suppose you partner has an inherited genetic condition, do you have the right to know before you have children?] I'm a lucky person [When taking a gamble].

Mental Health

Mental illnesses are quite rare; they are unlikely to affect most people. You can catch a mental illness from another person, like any other illness. There are no medical cures for mental illness, only therapy. Mentally ill people are often violent.

Evaluation 3

The Wellcome Trust commissioned an independent evaluation of the workshops that we ran for them in Science Centrestage. 682 questionnaires were completed by students, 162 by teachers and 85 by researchers (scientists) giving an excellent response rate of 94% for students, 97% for teachers and 93% for researchers. We also received written feedback from a number of teachers and scientists.

There was a clear positive response to the workshops from the different participating groups both in their enjoyment of the activity and in what they learned. A measure of the success of the workshops in enthusing and enabling the different audiences was evident in the high number, over 90%, who said that they were keen to continue their involvement in the project.

Table 1 - Enjoyment of Workshops

Question - How much have you enjoyed being involved in the workshop?

Very Much 5 4 3 2 1 Not At All

Students 37 44 16 2 1%

Teachers 53 39 7 1 0%

Researchers 56 40 7 1 0%

I really enjoyed being involved in the workshop because it's really helped me to learn about the more controversial sciences, such as the science of ageing, and I never really realised before how two completely different curriculum subjects could integrate together. School student, Bristol

I loved the way drama was blended with science...useful for me as a scientist in that it was good to see how GM is perceived and how I as a researcher need to communicate better to the public. Belfast researcher

Table 2 – Learning at the Workshops

Question - How much do you think you have learnt being involved in the workshop?

A Lot 5 4 3 2 1 Nothing

Students 25 40 26 8 1%

Teachers 30 39 25 5 1%

Question - Do you think the students learnt anything today?

A Lot 5 4 3 2 1 Nothing

Teachers 43 40 16 0 0%

Researchers 45 48 7 0 0%

Often students feel that science is very much a classroom subject and it's been fantastic to see the students really finding out that science is something that is happening around them - that every day research is going on. Science teacher, Somerset

A great opportunity. Our students loved it. I feel they really learnt a lot. Drama teacher, London

Very impressed with the level of debate and imagination of students. This was well stimulated. Researcher, Newcastle

Table 3 – Keenness to continue

Question - How keen are you to continue with Science Centrestage?

Very 5 4 3 2 1 Not At All

Students 52 30 12 5 1%

Teachers 74 17 7 1 1%

Researchers 54 38 5 3 0%

The workshop has prompted us to do science/drama work within school during the summer term and we may even take our ideas out into our feeder primary schools. In this way a much larger number of students will benefit from our experiences at the workshop day. Drama teacher, Warwickshire

I enjoyed it a lot. It has given me many new ideas that I can use during my teaching while discussing genetic engineering. Science teacher, Newcastle

Reservations concerning the workshop fell into five main areas - overall structure of the day, suitability of the space, drama content, science content and the role of the researchers. However, it is doubtful if any single cavil accounted for more than 10% of respondents.

Given the number of very different audiences involved in the workshop, it was not surprising that in some cases the activities did not meet the expectations of all the participants. Some drama teachers expressed reservations about the depth and quality of the drama input whilst a few science teachers and researchers thought that there should have been more factual scientific input.

I expected more focus on drama, how to use different techniques to explore issues Drama teacher

The day was more about drama than science which makes the role of the scientist superfluous
Researcher

The involvement of scientists in the workshops is a key feature. However, more could have been done to prepare the researchers for their role in the workshop.

Table 4 – Researchers' Role

Question - Were you happy with your role in the Workshop?

Very	5	4	3	2	1	Not At All
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Researchers	14	51	25	8	1%	
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Where the scientist's role in the workshop and subsequent activities was made clear the benefits were significant.

It was fun and enlightening. The country as a whole should do more of this kind of exercise.
Cardiff Researcher

Great - Projects aimed at taking real science issues into schools are in my view invaluable.
Glasgow Researcher

I've really enjoyed working with the school that I worked with. I really found it useful to myself because I've had to explain science at a very basic level to them and it's made me reassess the field for myself. Research Scientist, Bristol

As a scientist I must say I really enjoyed the event. My involvement in Science Centrestage, from advising and visiting schools to seeing the plays last Friday has inspired me more than I could ever convey. The final festival was very emotional for me and I was very proud to have played even my small role. I now have an appreciation of how important it is to convey and promote the role of science in society and how especially rewarding it can be to begin with children. I would love to be included in such events in the future. Research Scientist, London

The participation of the scientists was much valued by the teachers.

We have had a phenomenal response from both scientists - detailed and inventive. They really have collaborated demonstrating their expertise in the biomedical issue in accordance with our proposal. Moreover, demonstrating their creativity, enthusiasm and interest. Biology teacher, Glasgow

Obviously they are very different subjects, but we actually came together on this and I learnt a lot from her about Cystic Fibrosis and about the science involved in treating the disease, and she got a lot I think from working with the students on a different level, on a practical level, and dealing with an issue in practical ways. Drama teacher, Bedfordshire

Our experiences and the evidence from the evaluation of projects show that drama can be a very effective medium for the exploration and communication of science. There are a number of organisational difficulties in running drama workshops and with multi-disciplinary projects of this type it is not always easy to fully meet the expectations of all concerned and to integrate people successfully. However, it is clear that students, teachers and research scientists find the experience of working together in this way both rewarding and enlightening.

References: 1 www.ytouring.org.uk and Evaluation Associates 1997 Cracked: A study of impact
2 Full detail of Science Centrestage can be found at www.wellcome.ac.uk/centrestage 3 The Wellcome Trust, unpublished data