Teaching secondary school science through drama

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ABSTRACT There is substantial evidence that teaching science through creative methods increases pupils' motivation and their enjoyment of science. This has been found to be particularly true for those pupils who are not always self-motivated and who find learning easier when less formal techniques are used. Drama is an excellent method of bringing creativity into the classroom. The activities mentioned here, ranging from large ongoing projects to smaller five-minute mimes, can easily be adapted for the delivery of a variety of science topics to a wide range of pupils.

The importance of creativity

Creativity, one of the core skills recognised by the National Curriculum in England, is important for pupils' development. It has been found to increase pupils' self-esteem, motivation and achievement, help them to become more open to ideas, interested in discovering things for themselves and willing to explore ideas with others. It is also thought that creativity helps to prepare pupils for life in an ever-changing world and to develop many skills sought after by employers.

Motivation is extremely important in learning (Dierking, 1996), and often pupils who find the 'arts' subjects more enjoyable become demotivated when studying science as they do not see the relevance of the subject to their lives (Planet Science *et. al*., 2003). The Qualifications and Curriculum Authority (QCA, 2005) found that teaching creatively using techniques such as drama can help to increase motivation, leading to pupils conducting their own research and often delving deeper into a subject than would be possible within the time constraints of the classroom. Negrete and Lartigue (2004) propose that science should be '*hard fun*', which is a deep feeling of connection only made possible by imaginative engagement. Drama can provide this imaginative engagement.

To add to this, a number of psychologists, including Bruner and Vygotsky, have emphasised the importance of social learning. Unfortunately, this social aspect is often lacking in classrooms as teachers can be anxious about allowing pupils time to discuss the work in case they go off-task and limit their learning. Drama is obviously a social activity by its very nature. It can help pupils to be more relaxed when discussing their ideas, building on each others' thoughts and thus gaining a wider and deeper understanding of the topics.

While creativity is important for pupils and their learning, it is also important for teachers to feel they are being creative in their teaching (Mesure, 2005). Creative delivery of the subject matter helps to motivate and enthuse teachers. Using a wide range of pedagogical techniques helps energise lessons through mutual enjoyment of the tasks and the positive feedback received from the pupils.

One of the ways in which both creativity in teaching and teaching creativity can be incorporated into science lessons is through drama. The methods used in drama lessons can motivate pupils, improve focus and concentration, increase confidence in many facets of science and provide opportunities for teamwork. In addition, they can allow pupils to engage with issues in everyday life. Examples that can be adapted for use in the classroom are discussed below.

Barriers to teaching through drama

In my experience, science teachers are often reluctant to introduce 'creativity' into the curriculum and consider that it is the job of the art, drama and English departments to do so. In holding this belief, many fail to recognise that, without creativity, many of the advances in the sciences, mathematics, technology and business

that we often take for granted would not have happened. Many teachers also teach science in structured and organised ways, presenting the facts as clear cut and unambiguous, overlooking how creative scientists themselves have to be when inventing new products and approaches, solving problems and developing models (Creative Partnerships, 2005).

It has been suggested (Creative Partnerships, 2005) that in recent years factors such as the focus on raising attainment, which has led to a concentration on test and examination results, and the pace at which new initiatives are introduced have stifled creativity in schools, especially in science departments. This may be because teachers feel that they rarely have the time or space to develop more imaginative approaches or they are unwilling to try more adventurous teaching methods in case they jeopardise examination results. I suggest that using a more creative approach to teaching will not adversely affect these results but will enhance the wider learning experience of pupils in substantial and beneficial ways.

Drama in the science lesson

Large projects

Large projects, such as those funded by the Pulse funding initiative of the Wellcome Trust (see *Websites*), have been shown to be an effective method of using drama to teach and communicate science (CATR, University of Manchester, 2002). These have a substantial amount to offer and Parry (2005) argues that '*at their best, these projects have offered new ways of approaching science through a staggering constellation of metaphors and imagery*'. Parry also believes that it is not only the final performances that have made these projects so successful, but the confidence and learning gained by those involved. A case study often used to illustrate work developed through the Pulse initiative is 'Plague Nation'. This performance involved grains of rice being used to represent population statistics, including the population of Birmingham and the number of people who died from AIDS in 2003: '*Throughout the performance an ever-changing landscape of rice was created*' (Creative Partnerships, 2005). The outcomes of this project included emotive issues being tackled in an innovative way, which resulted in the pupils enhancing their confidence and self-esteem as well as having to be clear about the ideas before they could communicate them to the audience. This is a substantive example of how the performing arts can be used to enhance the learning experience of pupils in almost all the areas mentioned above. It was found (CATR, University of Manchester, 2005: i) that '*Pulse projects challenged the conventional understandings of science learning*'. This was achieved by challenging the conventional formats for learning science and helped pupils to engage with science issues in everyday life.

Pupils perform and write plays

A number of case studies have been published that demonstrate the successful outcomes from pupils writing and performing their own plays, with learning being enhanced in many of the ways mentioned above (Creative Partnerships, 2005; Mesure, 2005). They also created the opportunity for 'spiral learning', helping pupils to build on their previous knowledge. This opportunity is extremely important, as a substantial number of concepts and ideas are revisited throughout the key stages laid down by the National Curriculum. When revisiting these concepts many pupils 'switch off': they remember being taught something about it before and therefore think they know it. Creating plays is one way in which to develop and reinforce their knowledge and re-motivate them to learn about the topic.

'Case-study' and 'chat-show' methods

The 'case-study method' is an excellent way to help pupils examine moral and ethical issues from a more personal point of view. A well-illustrated example of how it can be used can be found in Gal and Klein (2000). Many teachers experience lack of interest from pupils when they are teaching topics such as cloning and the role of mutations in genetic disease. This may be for a number of reasons: pupils hear about these topics every day so feel they understand them already; pupils feel detached from the topics, thinking they are not relevant to them; and pupils do not think that they will ever have any influence in these areas. The case-study method can go some way towards overcoming these problems, and addresses a number of learning objectives including increasing knowledge, improving understanding, making pupils aware of ethical concerns, developing research techniques, and making pupils more aware of career possibilities in science. Pupils are presented with a case study revolving around a particular dilemma: carriers of cystic fibrosis are considering having a baby; a

person's father has just been diagnosed as having Huntington's disease. The class is then assigned to the role of a person involved in the story, such as the prospective mother, the prospective father, a genetic counsellor or a person affected by cystic fibrosis. Their next task is to research all relevant information in preparation for role-playing a conversation between the different characters. At this stage, guidance sheets can be provided as a planning template to ensure that all the relevant areas are covered. During the second lesson the pupils can be divided into groups comprising one of each character so that they can prepare and perform their role-plays. After the performances the pupils are asked to vote on what they would do if they were faced with that particular dilemma. One of the advantages of this technique is the flexibility it allows the teacher. Depending on the ability of the groups, the teacher can interject with questions leading the pupils to focus on different, or deeper, issues or can give pupils more freedom with their performances.

A variation on the case-study method is the 'chat show'. This increases the control of the teacher as the performance is a whole-class activity. Again, this can be used effectively to examine ethics and dilemmas related to a number of topics, including cloning, inheritance and environmental issues. One of the most successful ways of organising this is for the teacher to act as the host and assign the pupils different roles, be it as guests on the chat show or members of the audience. Unlike the pupils writing and performing their own plays, this requires a relatively small amount of time. After the basics of the topic have been taught, the pupils only need one lesson and a homework to prepare and then the performance can take place in the next lesson. This means that these two activities, along with increasing knowledge and understanding on all the levels discussed, can provide a formative assessment opportunity, and may be a more effective method for the teacher to assess understanding than a conventional test.

This method of setting up a debate where all the pupils have a role is an excellent way to discuss the history of scientific discovery – without the barriers of time. For example, the pupils could take on the role of people who have been involved in a certain area of research (e.g. Crick, Darwin, Wallace, Franklin, Mendel). They could find out about the work of this person and create the conversations that may have been possible if they were all alive at the same time. This provides an excellent opportunity for a blended learning project in conjunction with the history department.

The above three techniques allow each pupil to bring in some of his of her own personal experience and can impel pupils to learn for themselves, rather than 'for the test' (Gal and Klein, 2000). They also allow a deeper insight into the ambiguity of scientific knowledge and research, highlighting to the pupils that there are many things that we still do not fully understand and that there is not always a right answer to the issues. Gal and Klein hope that this feeling of discovery will '*translate into a lifetime of learning for all students that will be well served in this day when science is penetrating most facets of society*'.

Mime

Mime is an important tool used in drama. It can be particularly effective when used with lower-ability groups, as pupils do not have to overcome the barrier often presented by language in order to gain or demonstrate comprehension. It can also make the concepts being studied, such as particle models, diffusion and materials, seem more real to the pupils rather than remote theoretical concepts. I have used this technique a number of times with pupils of all abilities. I usually start by asking pupils to pretend to be an oxygen molecule trapped in a balloon in the corner of the room. When the balloon is popped they have to 'diffuse' across the room. Invariably the pupils will walk in straight lines to the opposite corner of the room. This allows me to invite the pupils to reflect on their 'performance'. As a class, after a small number of attempts, they work out how and why the molecules would move, and are then able to perform this mime accurately. From this it is easy to build up to more complex ideas such as gas exchange in the lungs.

Pupils have made various comments after taking part in these activities. The most common of these is that it makes the topic more interesting, relevant and fun. They feel that when they are actively involved the ideas make more sense to them. The following comment sums up the range of views well:

The role-play was fun as well as educational. I found that the drama helped to increase my knowledge of science as I was actively involved in the lesson. It is an excellent way of teaching science. (year 10 pupil)

In practice, I have also found that if mime is used as a starter activity for a lesson, as a recap of previous work, pupils often engage better with the following work. There may be a number of reasons for this; the most probable is that they are motivated right from the start of the lesson and their brains are active and focused.

Effective use of drama

Possibly the most important reason why drama might fail to enhance learning is when it is used as an 'add-on' and not fully incorporated into the lesson. If pupils and staff go through the motions and do not reflect on their work, ideas and movements, pupils will gain very little, as they will have little understanding of why they have carried out the activity. It is important to allow time for evaluation to take place. This evaluation must be rigorous, asking pupils to examine the strengths and weaknesses of discussing or presenting the topic in this way. For example, ask pupils to look at the limitations of acting out the solar system on the school field and prompt them, when necessary, to suggest ideas of scale and what cannot be shown in this way. In addition, it has been suggested (Mesure, 2002) that the use of plays is most effective when pupils create and perform their own. This suggests that it is the total and critical engagement on the part of the pupils that ensures these activities are fully enriching.

A major hurdle that must be overcome is teachers' lack of confidence in using these techniques and in their effectiveness. A number of factors may account for this lack of confidence. Firstly, there is little guidance for teachers on how to carry out drama activities. Although there are a number of articles on the use of such activities, teachers often still lack confidence in actually carrying them out with a class of 30 pupils as it can be daunting to try to control pupils in such situations. Also, the pressure on teachers to push pupils to gain top grades in all their examinations, combined with the time pressures presented by the extensive content of the Science National Curriculum, means that teachers may not be willing to take a chance on trying out new approaches. A simple way to reduce this problem would be to encourage teachers to attend workshops. Those who attend such workshops can also then disseminate the information and coach others, in their own or neighbouring schools, thus spreading knowledge of using drama as an effective teaching tool. Schools could also arrange training (INSET) sessions to help boost teachers' confidence in applying such techniques and to learn the ways in which they can be used. If attended by more than one department, these could improve relationships between departments and encourage cross-curricular projects. For example, I am currently collaborating with the drama department at my school to develop a play to help pupils' understanding of environmental issues.

Another issue is that of measuring the learning resulting from using drama. For example, it would be extremely difficult to quantify how writing and performing a play has impacted their inter-personal and kinaesthetic intelligences, as well as presenting a positive view of science to other pupils. In the climate of league tables and results, some may see using drama activities as a waste of time. Research in informal learning situations, such as science museums and centres, uses observations of pupil engagement to provide evidence for the effectiveness of different techniques. Unfortunately this type of research takes time, which teachers often lack. So how to measure the learning gained from such creative activities is an important issue. It has been shown (QCA, 2005) that when people are thinking and behaving creatively they display a number of behaviours, including: questioning; making connections and seeing relationships; envisaging what might be; exploring ideas; keeping opinions open; and reflecting critically on ideas and outcomes. These have been identified as indicators of learning in informal settings.

Conclusion

A number of issues surround the use of drama in teaching secondary school science: whether it is an effective method of teaching; the circumstances under which it becomes effective; the constraints of the prescribed curriculum; assessment of the completed work; and assessment of whether the activity enhances learning. Evidence is presented above to suggest that drama can be used effectively to enhance learning in science lessons. In order to achieve this, teachers must be confident in leading such activities, and this can be bolstered by adequate training and guidance. Time must be put aside to allow pupils and teachers to evaluate and reflect on the information and the activity. Just incorporating some role-play or asking pupils to mime the solar system will not enhance learning.

The drama techniques discussed will also arm pupils with a cognitive arsenal essential if they are to become scientifically literate citizens, able

to translate the world and media reports today and in the future. Included in this is the ability to manipulate metaphor (Parry, 2005) and the understanding required to assess scientific reports critically. In summary, using drama activities in science lessons will stimulate all levels of 'intelligence', motivate pupils, help them to see the relevance of science to their lives, and increase their ability to critically evaluate information presented to them.

It is worrying that there is still a climate in which many believe that science teachers should teach the objective facts and laws of science, while the subjects of citizenship and PSHE should be taught by RE teachers, and that these subjects have little in common and even less overlap. Until this climate changes in schools, we will be under-equipping our pupils as scientifically literate citizens. However, the activities and arguments presented above offer solutions to help break down the barriers between subjects, as long as the barriers in the minds of some teachers are broken down.

Fortunately, more resources and guidance on how to achieve this are slowly becoming available. Performing arts companies such as 'Y Touring' (see *Websites*), which focuses on science and ethics, are performing plays all over the country. Free teaching packs such as those from Creative Partnerships (2005) are also available. While complete schemes of work for all key stages are available to schools, accessing resources for extension and enrichment activities is still the responsibility of the individual teacher.

As the following quote indicates, drama can be an effective way of educating the 'whole' pupil and allowing them 'ownership' of their ideas and work.

> *By promoting creativity, teachers can give all pupils the opportunity to discover and pursue their particular interests and talents. We are all, or can be, creative to some degree. Creative pupils lead richer lives and, in the longer term, make a valuable contribution to society.* (QCA, 2005)

I therefore strongly believe that drama has a place in the science classroom and should be promoted as a teaching method which is valuable for both teachers and learners.

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