



Using Drama for Learning Scientific Concepts

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Abstract

Drama when used appropriately can help to expand the awareness of children, enable them to understand reality and science concepts through fantasy, and allow them to see the meaning below the surface of actions. Drama does not convey information about science to pupils, it helps them to use and see what they already know. Instead of throwing science concepts at students and expecting them to understand straight away, drama enables them to focus on a particular incident, observe a particular experiment, laugh at a particular joke and through the reality of the situation really understand the meaning behind the science. It enables pupils to experience events in a physical way helping them to conceptualise and increase their learning. Drama enriches the experience of learning science and learning all about the ocean.

The main aim of this presentation was to share with participants the experience of a group of student-teachers who used drama as a medium for teaching and learning scientific concepts. The presentation included three main parts. In the first part the presenters provided a rationale for using drama in the teaching of scientific concepts and making individuals more aware of issues dealing with oceanography; in the second part a small group of student-teachers shared their experience of using drama to communicate science concepts with pupils in the classroom; and finally the session ended with the interactive engagement of all the participants in a small drama workshop where it was possible for the participants to try out first hand the theories and experiences discussed in the first and second part of the session. This session sought to offer participants new ideas and alternative methods of teaching oceanography with enthusiasm, humour and enjoyment

Introduction

What do Science and Drama have in Common?

What do science and drama have in common? How can drama be used in the science classroom in order to motivate students to learn science and enable them to learn scientific concepts in a fun way and in a way which they can remember? One way of teaching science successfully is to ensure that students are engaged in numerous hands on activities that encourage inquiry based learning, opportunities for simulation exercises, freedom to explore and discover, and laboratory exercises that bring textbook lessons to life (Swango and Steward, 2003). Science is also a process which involves problem solving, discovering or determining cause and effect, making inferences, drawing conclusions, classifying, predicting and hypothesising and building models. These skills need to be learned and the role of the educator is to allow students to become comfortable with asking questions, making mistakes, justifying answers. They need to "learn how to think" (Jorgenson, Cleveland and Vanosdall, 2004).

These skills cannot be acquired by traditional instruction and transmission of knowledge. Something more is needed. Drama in science can provide the context within which the dilemmas and problems of "real life science" can be enacted and used as a learning tool to enable students to debate, discuss, hypothesise and understand the concepts of science within a safe environment. Dorothy Heathcote (a well known educator and researcher in educational drama) states that, "drama is human beings confronted by situations which change them because of what they must face in dealing with those challenges" (Johnson and O'Neill, 1984, p. 48). Drama helps to engage young people and learning communities in discussions and debate about various issues regarding for example the ocean, the state of the ocean, the beauty of the ocean and the impact of mankind on the ocean environment.

Bentley and Watts (1989) describe four main reasons for choosing to explore science through drama and role play. They state that first of all it is an important way for the teacher to retain control of the focus of the lesson to be learnt, but at the same time devolving responsibility for the learning to the students. Secondly, it allows the learners to make appropriate judgements about attitudes, values and feelings, as well as facts and concepts. Thirdly it encourages oral communication and allows students to put ideas into words and fourthly it builds on the learners'



experiences, and allows them to relate their experiences to the outside world. Drama operates at both the social and cognitive level and "it provides students with a space within which to link scientific and spontaneous concepts. It traces the continuities between the more formal aspects of the science curriculum and issues relating to the social, personal and political development of the individual" (Bentley and Watts, 1989, p. 147).

The idea of using drama in science teaching as explained by Heathcote and Bolton (1995) is not to just produce a play and have actors in it, but drama when used appropriately can help to expand the awareness of children, enable them to understand reality and science concepts through fantasy, and allow them to see below the surface of actions to their meaning. Drama does not convey information about science to students, it helps them to use and see what they already know. Instead of throwing science concepts at students and expecting them to understand straight away, drama enables them to focus on a particular incident, observe a particular experiment, laugh at a particular joke and through the reality of the situation really understand the meaning behind the science. It enables pupils to experience events in a physical way helping them to conceptualise and increase their learning.

Inquiry Based Science Learning

Bransford, Brown and Cocking (1999) suggest that understanding science is more than knowing facts. Most important is that students understand the major concepts. Constructivist views of learning suggest that learners are not passive recipients of knowledge; rather they are active constructors and re-constructors of their own understanding. Mental representations are continually being confirmed, rejected, adapted, reformed or developed in response to experiences both inside and outside school. Learning also depends on what the students bring with them into the classroom (Bruner, 2004). Bransford et al. (1999) also state that learning takes place within a social context and learners in science need to be provided with opportunities to interact with others and communicate ideas and listen to alternative explanations. This approach to teaching and learning science is known as "inquiry based learning". "Inquiry learning not only contributes to better understanding of scientific concepts and skills but because science inquiry in school is carried out in a social context, it also contributes to social and intellectual development" (Ansberry and Morgan, 2005, p. 19). The learners of whatever age can work collaboratively and ask thoughtful questions about science and environment in a context which mirrors the real social environment in which they are taking place. Hodson (1998) states that there are clear messages to teachers about the need to enliven science teaching and learning. "Features that increase students' situational interest include challenge, choice, novelty, fantasy (a much neglected aspect of science education), surprise and of course, personal, social and environmental relevance" (Hodson, 1998, p. 71). Drama through inquiry based science is ideal for achieving all these features.

The characteristics of inquiry based science learning as identified by the National Science Education Standards (NRC, 2000) can be enacted in the science classroom using drama:

1. *Learners are engaged by scientifically oriented questions.* In a science lesson which tries to engage students with ocean issues, the students are initially engaged with describing what comes to their mind when they hear the word "ocean". This places the ocean within a realistic context which students are familiar with. Other issues can start with questions regarding a particular scenario. For example questions like, "You are living in Alaska and the water level is rising...What would you do?" can be asked. As stated by Gough and Griffiths (1994), "feelings are explored, insights are gained, and problem-solving abilities enhanced as the students project themselves into real-life situations" (p. 261).

2. *Learners give priority to evidence which allows them to develop and evaluate explanations that address scientifically oriented questions.* In this case students can carry out a number of investigations which allows them to reach the answer to a number of questions regarding the ocean. They can be asked to classify or identify endangered species. They can be asked to measure the salinity of a particular sample of seawater or to test for the amount of oil or pollutant in a sample of seawater. In this case the learners are taking on the role of scientists and environmentalists and they have to provide answers to the scientific questions, asked previously.



The dramatisation in this case is not based on a prewritten script but the script and the answers are developed as the investigation progresses.

3. *Learners formulate explanations from evidence to address scientifically oriented questions.* Students can be presented with a hypothetical question regarding the polluted state of the ocean. They can then formulate their own explanations from evidence and have a round table discussion where some students represent scientists, environmentalists, journalists, politicians and business men. There is no prewritten script and the students reach their own conclusions.

4. *Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.* The learners, students or young adults are safe to explore within the limits of role play and dramatisation their own ideas and views which do not have to be right or wrong. The coordinator, teacher or facilitator of learning can then present alternative situations which students/learners can explore within the safety of drama. The can evaluate, re-evaluate, and feel safe that they are not making mistakes, but only giving alternative endings to the script of real life.

5. *Learners communicate and justify their proposed explanations.* Communicating results is one of the most important skills which needs to be learnt in science and especially in science teaching. Students can be asked to write a story or develop the script of a play which they can then act out in front of friends or other children in the school. If the students are older then they can present the play in front of members of the community in a local parish hall for example. All that the students/young adults have learnt about the ocean or any other scientific issue is presented to the local community.

Drama in inquiry based science learning provides students/learners with a variety of opportunities to practice what they have learned, connect to what they already know, and this prepares them to solve problems in new situations. It mirrors the social context in which "real science" takes place (Ansberry and Morgan, 2005) and allows students/learners not only to develop knowledge and understanding of science, but also their social and ethical understanding of issues dealing with science and the ocean. For Heathcote quoted in Johnson and O'Neill (1984):

Drama uses the person to bring it into being. Conversely, the person is brought into possible new being by the same process. The child enters the zone of circumstance permitted by the drama situation, and in shaping the circumstance's future, the child's future is shaped, ready to be available in the real society which at present seems cut off from the school (p. 198).

Getting Pre-service Science Teachers to use drama and scientific inquiry to teach Science Concepts

Using drama as a tool to teach science concepts is not a new idea but the question which needs to be asked is whether all science teachers are equipped and confident about using drama to teach scientific concepts. For pre-service science teachers to understand the importance of drama and its great potential as a learning tool, they need to experience the impact of drama themselves. As teachers it is also important to learn the communicative, confidence building skills developed by engaging with drama. Dorothy Heathcote quoted in Johnson and O'Neill (1984) states:

So we need to train our teachers to structure for a learning situation to happen rather than sharing of information in a 'final' way to take place. We have to train them to withhold their expertise to give their students opportunity for struggling with problems, before they come to the teacher's knowledge, and to reach an answer because of the work they do rather than the listening they have done (p. 29).

To this end science student teachers in the Faculty of Education participate in a teaching module entitled "Drama and Storytelling in the Science Classroom". This unit is carried out in collaboration with Masquerade Theatre Arts School. The Director of the school, Mr. Anthony Bezzina, works with the science student teachers to develop their own personal communicative skills as well as set up a production in which the student teachers teach science concepts through



a short play. The first module was carried out during the academic year 2006-2007 and the B.Ed.(Hons.) third year science students adapted the play by Roald Dahl George's *Marvellous Medicine*. The magical world of George who makes his Grandma grow big through his *marvellous medicine* is linked with the world of science and observation and finding an explanation for why things happen.

The play itself was the end result of a number of drama workshop sessions where the science student teachers learned how to project their voice, achieve poise and presence to carry themselves with ease, the skill of communicating with others which is essential for any teacher, and most of all how to cut loose from all boundaries and touch the limits of their creativity. The drama sessions allowed the student teachers to explore their inner abilities and enabled them to develop the skills needed for them to become competent and professional science teachers. At the same time they learnt how to use drama as a teaching and learning medium which when used in their science classrooms would make the science they were teaching much more fun for the pupils in their classrooms. As pointed out by a student teacher:

We learnt how to project our voice, look at the persons we were talking to and even use related gestures to simplify our communication. All this is important for us in the classroom. It also helped to improve our self-esteem...

The drama sessions also helped the student-teachers work as a group. Very often life at University is very competitive, instilling in students the need to work on their own to achieve better than their colleagues and to strive for the better grades. They were still striving for excellence, but the achievement of the whole group was more important in this case. As stated by another student teacher:

Making the props and the set with my best friends was real fun. It is something that I will look back at and miss very much. This also served for the whole group to get together and work really hard because all of us wanted this to go well...

But how could a play written by Roald Dahl be used to teach science to young student? In George's *Marvellous Medicine*, the student teachers used the Roald Dahl idea, but adapted it into their own text, to be able to introduce some basic science concepts. For example George mixed vinegar and baking soda to make his medicine, and the mixture erupted with many bubbles flowing out of his flask. He then attempted to solidify his solution by adding corn flour to make goop. His imaginary friends created in the text to give explanations for what was happening, constantly explaining the science behind the text. They explain about the food pyramid and what food is good for us to eat, about how we can make a paper fly across the room, and why a parachute falls to the ground. And all of this intermingled with chorus songs and dances composed and choreographed by the student teachers themselves. The colourful set, the narration and humour of the student teachers all helped to make an enjoyable production for all concerned. And all of this out of individuals who were not trained actors, but were simply teachers trying their best to find a method which would motivate their students to have fun learning science.

The performance itself was held at Stella Maris College Junior School. Two shows were held for the Grade 4 boys and for the Grade 5 boys. The boys packed the hall and with their enthusiasm, really energised the student teachers and enabled them to give a good show. For one student-teacher:

Today when I was on stage and I saw the students engaged in what was happening, I felt really happy and satisfied. I felt that we had achieved our aims...

Yes the aims were achieved and this was visible in the interaction which went on between the student teachers and the boys at the end of the show. The boys wanted the recipes for making George's medicine. They wanted to know what a solution was and how they could make one. They wanted to know more about NASA. They wanted to know how to do all the experiments performed on stage. Through this way of "doing science", the students and learners "acquire valuable skills through their interaction, collaboration, and problem solving with other students -



skills that cannot be learned sitting in desks in rows and listening to a teacher" (Jorgenson, Cleveland, and Vanosdall, 2004, p. 19). The excitement and energy of the learners and student teachers was visible all throughout the play. As one boy pointed out:

The play was so much fun and it helped me learn a lot about science in a fun way. It was also very funny and I liked the bits when grandma grows big and George makes his medicine. Now I will go home and try out these experiments...

But what was most successful was the communication which developed between the student teachers and the boys. The boys were only seeing these student teachers for the first time, yet at the end of the show they were stopping them and asking them questions about the play, thanking them for a fun session and a great show and most of all being open and friendly in a positive manner. This is the essence of good teaching and the first lesson that every beginning science teacher must learn. And these student teachers learnt the lesson in a fun way and at the same time managed to teach something to the boys at Stella Maris College too. Hopefully, these student teachers will carry with them the memory of George's Marvellous Medicine into their classroom practice and enable them to make the teaching of science fun for all their prospective students. As stated by Mr. Anthony Bezzina, at the end of the presentation:

...the science student teachers were in some way or other initially made to do this presentation as part of their credit. A very interesting development as happens with young drama students – the enthusiasm finally took over – this became something they wanted to do and see through to the end. They learnt skills for life which they will pass on to their pupils. A very credible training for student teachers indeed...which highlights the cliché...all the world's a stage...

Conclusion

The goal of any science teacher goes beyond the simple transmission of scientific knowledge and known scientific facts. A central goal of science teaching should be based on the initial premise that science is not value free and should aim to:

...equip students with the capacity and commitment to take appropriate, responsible and effective action on matters of social, economic, environmental and moral-ethical concern. The keys to this translation of knowledge into action are *ownership* and *empowerment*. Those who act are those who have a deep personal understanding of the issues (and their human implications) and feel a personal investment in addressing and solving the problems. Those who act are those who feel personally empowered to effect change, who feel that they can make a difference (Hodson, 1998, p. 21).

Through drama the students/learners can become personally involved in the understanding of scientific and environmental issues. Students/learners can learn how to express their own views and ideas, engage in discussion with teachers and peers, evaluate their views and if necessary adjust their views to new situations. Within the safe context of drama, students/learners become empowered and they are encouraged to become more committed to "fight to establish more socially just and environmentally sustainable practices" (Hodson, 1998, p. 22). This commitment and empowerment can then be directly translated to real life situations.



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