

THE NATURE OF SCIENCE DRAMA IN SCIENCE EDUCATION

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Abstract

The use of educational theatre has been studied and developed mostly in language education in Korea. With emphasis on scientific literacy and STS movement, its possible use in science education was increased. This paper is a reflection on the meaning of effort incorporating drama in science education by figuring out characteristics of drama.

As introduction, it is shown that there could be many kinds of science drama science educators can use, then as its main feature 'story' and 'live-ness' are pointed out. The 'story' of science drama enables empathetic learning, the 'live-ness' arisen from present action of participants facilitate students' participation and interaction with the story. These characteristics can contribute humanistic approach in science education still have challenges for science educators how incorporate distinctive science knowledge into humanistic educational aims. The practical use of science drama as a teaching tool, a learning process, assessment tool will be proposed with exemplar.

Keywords: science drama, story, live-ness, science education

1. Introduction

Many young children enjoy playing house, a kind of drama. Many adults as well as children like drama in theatre or on TV. Science seems very far from, even contradictory to this emotional and cultural activity. But 'The Blegdamsvej Faust'¹ performed in 1932 by Bohr's students was a good communication way of new science concept among scientists. Recently theatre like 'Oxygen'² and 'Copenhagen'³ which dealt with scientific themes were pretty popular among the general public. This example showed science could be a good theme for drama, and contrary drama could do a lot for communication of science among general public or even scientists.

Educational theatre, which aims to improve education through drama or its technique, has developed and studied mostly in language education in Korea. Traditionally, we science educators emphasized experiment and investigation based on evidence, planned observation, logical thinking. Can science drama be incorporated in this rational science teaching? When we use drama in science classroom is it necessary for genuine science teaching or just for fun to avoid boring science?

This paper is a reflection on the meaning of effort incorporating drama in science education. Some practical use will be explored as well.

2. Type of science drama in classroom

With emphasis on scientific literacy and STS movement, recently there have been some trials and studies on science drama including role play even though not as many as other issues in science education. Odegaard(2003) well summarized these effort and showed diverse possible type of science drama according to three science education dimensions: science as a product, the process and nature of science, science as an institution in society. He categorized science drama as explorative, semi-structured (role-play) and structured. Where structured science drama mainly teacher initiated and presentational, explorative one is usually students initiated and experiential. There could be many other criteria to discern the type of science drama in classroom. It could be divided into with-scripts and without-scripts. The following is the categorization and the examples of relevant studies or materials.

¹ A drama, written by Bohr's students, performed at the conference in 1932, tenth anniversary of Bohr's institute. This is based on Goethe's classical drama 'Faust'. Pauli who suggested new theoretical particle (neutron, today called neutrino) corresponds to Mephistopheles, Ehrenfest to Faust, Bohr to God, Pauli's weightless particle to Gretchen. It starts from a bet between Pauli and Bohr. Pauli insists he can sell his new idea (weightless particle) to Ehrenfest (Pantidos, et al., 2001).

² The script of 'Oxygen' was written by prominent chemists, Carl Djerassi and Roald Hoffman. It deals with contribution of three scientists (Lavoisier, Priestley, Scheele) on the discovery of oxygen, questioning the meaning of real discovery in science.

³ A theatre play 'Copenhagen' by Michael Frayn attracted large audience on many prominent stages around the world. This play deals with issues of atomic bomb making, around Heisenberg's visit to Bohr's laboratory in Denmark in 1941(Bergstrom et al., 2001).

Table 1. Types of science drama

Type	Outline	Example
With -scripts	Performance	Scripts provided by teacher or existing one, students act the script "Mom, My blood type is O" (Yoon et al., 2004)
	Readers- theatre	Scripts provided by teacher or existing one, students read the script "Experiments and Readers theatre" (Haven, 1996)
	Creation	Students write their scripts and act "Gene-ghost" (Odegaard, 2003) "Chemistry on stage" (Budzinsky, 1995)
Without -scripts	Role Play	Role description, context are given, students improvise act according to their role "Deciding evolution's place in the science curriculum" (Bentley, 2000) "The story of vaccination against smallpox" (Solomon, 1991)
	Improvisation	Task or context given, students decide the cast and improvise their act. It includes non verbal representation like gesture or movement. "Electric drama" (Braund, 1999)

Science drama can also be categorized according to its theme (Yoon, 2004): 'Science concepts drama'- represent science facts or knowledge, 'Science character drama'- show scientist's life story, 'Science history drama'- show memorable scientific event or development process in history of science, 'Science debate drama'- deal with social issue of science and technology, 'Science expression drama'- focus artistic expression using science symbols or new technology.

This diverse classification reveals there are many possible ways of using drama in science education. Science educators can choose one or adapt for specific educational purpose.

3. Characteristics of science drama

In previous section, it was told that many kinds of science drama can be tried in classroom. Then what are the main characteristics of this science drama activity? Do they have some similarities or dissimilarities with traditional science teaching activity? Although there are not enough studies or common recognition on these science drama characteristics among science educators, I think two things of science drama are worth of focus. One is 'story' it has, the other is 'live-ness' of its performance.

Sometimes it is only gestures or body action like mime without words, even in those cases, most of science drama has 'story'. The story consists of events, characters and settings arranged in sequence (Carter, 1993) usually enables peoples' emotional participation. The story due to its life-likeness enables learning with affect that is empathetic learning. Solomon (2002) also pointed out stories in science education contribute to understanding of nature of science, taking discussion of ethical problems by empathetic quality.

In traditional science education, students can be delighted and surprised with hands-on experiments and well designed demonstration, but empathetic learning will hardly occur through experiments designed to rehearse scientists' way of work. Rather, emphasis on objective experiment or accurate measurement seems to exclude these emotion from science. Scientific knowledge was regarded as abstract outcome by emotion-free process.

Though it is not sure 'emotion' might be excluded in scientific process, if we want to science contribute more to general education as whole personal development, and see cognition can not be separated with affect, we have to more concern. Obviously not all the story could be meaningful to students, and stories itself could be another burden of memories. Many written texts and multi media material could have story structure. Yet it is not clear if these story structure facilitates learning, what kind of story is meaningful to learner.

'Story' itself is considered as a mode of knowledge. Bruner (1986) spoke of narrative mode of thinking, Sarbin (1986) said that human beings think, perceive, imagine and make moral choices according to narrative structure. Also science teachers' specific explanation can be regarded as using narrative mode, offering a contextualized story of science (Stinner, 1995).

Another characteristic of science drama is the 'live-ness', quite subjective and cautious interpretation of mine. It is from 'present' tense and 'action' of participants. It unfolds in the eyes of students through their actions. In that sense 'live-ness' of science drama is similar to experiments or demonstration. In case of science drama, with much less cognitive burden than experiments, students' verbal expression sometimes in another's shoes can be easily facilitated. And this 'live-ness' of science drama make students' participation and interaction with the story occur easily rather than written texts or multi media animation.

Science education needs live natural phenomena and events, but also need live students' participation. Science drama offers large room to students to talk, express, adapt and evaluate their science knowledge and thought by its 'live-ness' and this results in unauthoritative learning environment.

4. Place of science drama in science education

'Science for all' agenda has brought more humanistic approach which is appreciative, empathic, personal, and imaginative in science education. Donnelly(2004) argued many recent science education reform like STS movement and open investigation oriented curriculum are strongly associated with educational characteristics of humanities.⁴ He agreed the legitimacy of these humanizing projects but pointed out the risk of losing distinctive quality of natural science that is physicalist account of the world. He said science knowledge is in its own right a humanizing study, but its quality is distinctive. A body of curricular content is not humanities, it is authoritative and physicalist.

Science drama is also in the way of this humanizing effort, but the humanistic educational purpose of science education can not be separated from its content, scientific knowledge. This can be thought as dilemma situation. One hand we have authoritative established science knowledge, which is expected to transfer to our students, the other hand we have humanistic aims of science education which is expected to contribute general liberal education. As a teacher, this situation is often encountered. In STS issue discussion, students' decisions do not depend on science knowledge and science teachers are not comfortable often with political, ethical, economical decision detached from science knowledge though they are STS advocates. Usually students' open investigations do not end with expected scientific explanation in spite of much time and effort. Many teachers want to provide genuine autonomous investigation opportunity for students at the same time, the results confined within science curriculum content as still they have a body of knowledge to teach. It is not fault of extremely cautious teachers or compulsive national curriculum.

Science drama could be also a waste of time and effort for understanding formative science knowledge. Here lays our difficulties and challenges in incorporating science drama in science education. It is difficult challenge but we have some successful reports. More trials and effort of science educators will make the use of science drama possible in variety settings.

If we want science contribute as general education, we need to address humanistic educational aims of science. Science drama could be ineffective in acquiring established science knowledge, but could be more effective in communicating science and could serve this humanistic aims. Still in using science drama, we have to be careful about scientific knowledge included. If it provides no room for science knowledge learning, it is difficult to become a part of science education. Science drama should base on sound scientific idea, regardless of its type and specific educational purpose. The drama includes some science terminology, or well known scientist as a cast without pursuing communication of science based on scientific knowledge, can not be called as 'science drama'. Science drama is expected to give humanistic nature on its authorized scientific knowledge by emotional and active participation.

5. Practical use of science drama

Practical use of science drama in classroom could be suggested in three ways. Firstly it can be designed as setting the scene, providing useful context for learning. To stimulate learning activity, short time drama either prepared before or improvised can be performed. It should be followed by proper learning activities like discussion or experiment. For example, misconception dialogue among students actors followed by confirm experiment, future imaginary news followed by discussion on STS issues. Science historical story also can provide good start point for learning relevant concept. Yoon, Jang & Na(2004) explored the usefulness of science drama in primary school. Ten minute's drama 'Mom, My blood type is O' performed at the beginning of lesson, was successful in making students (grade 3) understand the knowledge related with heredity of blood type (71% of the students got perfect answer).

Secondly, drama making is as learning process. It aims that learning occurs during preparation of science drama. Gene-ghost(Odegaard, 2003) is a good example. Students were challenged to look at their understanding on biotechnology, compare it with the Norwegian public's opinion and develop it into a play using Henrik Ibsen's figures. They learn about biotechnology knowledge as well as other literary knowledge during their drama preparation.

Thirdly, drama as a representation offers an assessment opportunity. Although assessment can not be separated with learning completely, drama can provide opportunity to see what students know, think in unique way. Budzinsky(1995) asked students prepare a staged mini-production which included aspects of the scientist's personal life and professional accomplishments. The students' performance must portray, through replication or simulation, the research and experiments that led to a significant contribution of the scientist. Through this performance he can make students learn more chemistry and see their understanding of important chemistry concepts or experiment. Kamen(1991) pointed out where many assessment require students restate a definition, creative drama is unique in that it requires students demonstrate their understanding in a way that is meaningful to them. He exemplified pantomime of air molecules when temperature increase, movement to show wavelength, amplitude and resonance.

Especially science history offers many good themes for dramatization. Many science educators have argued including history of science in science teaching not for itself, but for better science understanding. It provides

⁴ He pointed out four characteristics of humanities. : An appeal to an autonomous self; Indeterminacy in subject matter; Meaningfulness in subject matter; Meeting the challenge of relativism.

knowledge on the nature of science like tentativeness of science theory, experiments as trying explanation. It can also provide specific concept development process, how the ideas first developed(Wang & Marsh, 2002).

An intelligible story of why a certain scientific concept is borne could facilitate students' assimilation of a concept as well as an understanding of process of science. Sometimes historical experiment which is difficult to revive in classroom can be revisited with its scientific significance through drama.

6. Conclusion

Yet there are not enough materials or studies on science drama for science education, there is some positive empirical reports on science drama. Odegaard(2003) argued that pedagogical advantage of drama is to create non authoritarian and creative learning environment, opportunities for meta cognition with empathy.

In this paper I tried to reflect on the meaning of effort incorporating drama in science education by figuring out characteristics of drama. That attempts empathic science learning, through 'story' structure and active communication on science through 'live-ness'. It is in the line of humanizing project as Donnelly(2004) referred. Yet its use in science education is not easy since scientific knowledge is quite distinctive one unlike other discipline.

The 'story' of science drama can touch emotion that students hardly experience in usual science classroom. The 'live-ness' can facilitate students' active participation. Science drama is expected to give humanistic nature on its authorized scientific knowledge by emotional and active participation.

There are some practical ways of incorporating science drama in classroom as a teaching tool, a learning process, and an assessment tool, especially history of science can provide good resources for many purposes.

7. References

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