Caribbean Curriculum
Vol. 15, 2008, 25–43

USING ROLE-PLAY TO DEVELOP SCIENCE CONCEPTS

Rawatee Maharaj-Sharma

There is an urgent need in science education to explore new and innovative ways to teach science to children at all levels of the education system in ways that will pique their curiosity and hold their interest. This article reports on the use of role-play to develop children's ideas and understandings about energy concepts and energy conservation issues/practices. The findings show that children retain many abstract science concepts when taught using this approach and, further, that this method of instruction allows them to make linkages and distinctions among several energy concepts and to appreciate the importance of energy conservation.

Introduction

Role-play is an exciting and creative way to develop children's science ideas by allowing them to physically participate in their science learning, thereby making the experience more memorable.

This article explores how children's science concepts and ideas can be developed using role-play. Recent developments in science teaching and learning have suggested that while practical hands-on activities are useful and effective ways to foster conceptual development in science, other activities that allow for psychomotor engagement as well as expression of emotions and feelings can be equally rewarding and stimulating for science students (Banister & Ryan, 2001). The focus in this project is on learning about energy concepts, including energy conservation issues and practices, in a Standard 4 primary school classroom. The approach adopted will be described, the findings as well as the benefits of the approach will be presented, and some of the challenges encountered in implementing the approach will be identified.

The aims of this project are to investigate the ability and potential that role-play has to:

1. develop students' conceptual understandings about energy and energy-related concepts;

2. explore students' views/feelings about energy conservation practices.

Literature Review

Best practice in science education, as reported by Haury and Rillero (1994), is often perceived as being based on practical activities to facilitate hands-on learning, in order to allow children to build knowledge and develop scientific understandings. The role of the teacher in such instances becomes that of facilitator for such scientific experimentations. Goldring and Osborne (1994) and Millar (2002) have suggested that while there are tremendous benefits linked to the use of activities of this type, practical activities might not always be the best way to introduce a new idea or to facilitate the grasp of conceptual understanding.

Craven and Penick (2001) have suggested that role-play in the classroom has the potential to capture children's attention and to stimulate their imagination, thereby making it a useful strategy for science teaching. Graber et al. (2001) have further suggested that role-play is a good way to liven up science teaching and develop the students' interest in science. The versatility of role-play as a teaching/learning strategy makes it appealing at all levels of the educational system and for a variety of abstract science topics. Francis and Byrne (1999) reported that using role-playing exercises in the teaching of physics and astronomy, even at the undergraduate level, "deepens student understanding and dramatically increases the level of classroom interaction" (p. 206).

McSharry and Jones (2000) provided a theoretical basis for the use of role-play in science teaching and also presented some ideas that can help science teachers develop role-play scenes. Bonnet (2000) used some of the ideas suggested by McSharry and Jones to develop role-play scenes that were used to analyse the impact of the strategy on the learning of children aged 8–10 years. He found that not only did the strategy actively engage students in science learning but it also facilitated the emergence of values such as tolerance, responsibility, and autonomy among students.

In work on using role-play in the classroom, involving three teachers and a university academic, with mixed-ability classes from three high schools in New South Wales, Ladrousse (1989), reported that role-play had

tremendous potential to allow students to demonstrate their understanding, explore their views, and develop deeper understanding of phenomena. Building on the work done by Ladrousse, Aubusson, Fogwill, Barr, & Perkovic (1997) found that while role-play provided tremendous affective gains for students, its use to portray ideas, promote discussion, and facilitate scientific analogical reasoning among students could not be ignored.

Dallman-Jones (1994) posited that there are two different kinds of role-play that can be used in the classroom. Type I involves having children act as if they are components of a physical or biological system, for example, atoms of a molecule or organelles in a cell. Type II involves an ethical issue, and students act as humans in a situation where a decision must be made, for example, making a decision about whether or not a teenager should have an abortion. In this type of role-play, different children are given brief descriptions of the role they will assume and may be asked some stimulating questions during the role-play exercise to reveal insights about their views and feelings about the topic of the lesson. Adopting Type II role play in a study involving primary school science students, Dallman-Jones further reported that the intricate relationships among the role-players in a variety of situations allow children to show their understandings about the particular character they are impersonating, and also to recognize the relationship they have with the other role-players.

In this work, Type II role-play will be used as children explore their understandings about energy and energy-related concepts as well as their views and feelings about energy conservation practices.

Methodology – The Approach

The investigation was carried out in the science classroom of a Standard 4 primary school, located in central suburban Trinidad. The class consisted of 29 children aged between 9 and 11 (males and females) of mixed abilities. An overview of previous formative and summative assessments of the performance of students in tests done the previous term revealed that there was a range of performance among the students, with some scoring very high marks (85% and above) and some scoring

very low marks (20–35%); but with 60% of the class scoring in the 40–80% range.

To maintain confidentiality, a number was used to refer to each child. The topic "Energy — Concepts and Conservation" was chosen because this was the topic the teacher was teaching in the normal course of the term at the time the project was undertaken.

The entire project consisted of five segments as shown in Table 1.

Table I. The Five Segments of the Project

Segment	Timing	Activity
1	Week 1, Day 1	Gauging children's prior knowledge/ understandings about energy, energy consumption, and transformation processes
2	Week 1, Day 3	Introducing the role-play about energy consumption and transformations
3	Week 2, Day 2 & Day 4	Children act out the role-play
4	Week 2, Day 5	Finding out what new knowledge and understandings children gained about energy, energy consumption, and transformation processes
5	Week 6, Day 2	Interview with students

Segment 1: Gauging Prior Knowledge/Understandings and Feelings

In this segment, the children wrote responses to five open-ended questions:

1. What is energy?
2. Where does energy come from?
3. What is energy used for?
4. What happens to energy when you "use" it?

5. How do you feel about energy that is wasted?

Each question was read aloud to the class and the children had about five minutes to individually respond, in writing, to each of the questions. Children with spelling, writing, and other literacy challenges had their responses tape-recorded.

Segment 2: Introducing the Role-Play

The information gained from Segment 1 was used to create a role-play [by the researcher in close collaboration with the class teacher] called "The life of Eddy Energy," which incorporated a number of scientific ideas the children had learned earlier in the term, as well as ideas and understandings emerging from their written/verbal responses to the questions in Segment 1. Scene 1 formed part of the introduction in which the play started by addressing the first question in a scene in which Eddy Energy is a new student and is asked to introduce himself to his classmates. Some of the other students also introduce themselves as various devices that need energy in different forms, for example, Anthony Airplane, Susan Skater, and Terry TV.

[Throughout the enactment that followed, the researcher sat in the classroom, mostly as an observer, taking notes and interjecting occasionally—when requested by the teacher either to assist children with their costumes or to repeat a response made by a student—but it was primarily the class teacher who facilitated the enactment by guiding students through their roles, asking questions, probing responses, and writing students' responses on charts posted on the walls of the classroom.]

Segment 3: Children Act Out the Scenes

In the following four scenes, which constituted Segment 3, Eddy interacted with his new friends in a variety of situations all tailored to introduce and expose students to concepts, ideas, and relationships aimed at developing the understandings embedded in the last four questions in Segment 1. Each scene addressed one of the questions. In Scene 2, Eddy is asked by his friends to explain more about himself, and the conversation continues along with the acting between Eddy and his new

friends leading to an exploration and an eventual uncovering of the sources of energy. In the following scene, Scene 3, Eddy is asked to share his talents and to show his friends some of the things he can do. In this scene, Eddy interacts extensively with his friends, showing them that while each of them has a particular skill or talent, there comes a time when they would each need help to continue to do their respective jobs. The scene unfolds as Eddy shows himself off, indicating his numerous abilities and that he can help each of them do their jobs either faster or for a longer period. In the fourth scene, Eddy and friends are having a wonderful time, with his friends repeatedly calling upon him for assistance to carry out their respective tasks, until, in the latter part of the scene, Eddy begins to feel exhausted. He is unable to help them with the same rigour as he did at the start of the scene; he becomes hot and sweaty and eventually he has to stop because he cannot continue to go on. His friends, too, no longer having that continuous help, eventually have to stop performing their respective tasks. They too become tired, hot, and sweaty.

Each scene of the role-play was complemented with large charts on the wall, on which the teacher wrote the responses of students to structured questions she posed to the students at selected points during and at the end of each scene enacted. The questions posed to the students for each scene revolved around the main idea in the scene, which emerged directly from the questions in Segment 1. For example, throughout Scene 3, the teacher asked several questions encouraging students to think about how is it possible for Eddy to help each of them even though they were each doing different things. The idea was to get students to realize that while Eddy is one individual [one thing], he can function in different roles or forms, so that the idea of energy being transformed from one form to another, depending on the demands of the situation, was brought into focus in this scene. At the end of Scene 4, the teacher asked the students to think about why Eddy becomes hot. She used their responses to lead into a discussion about energy being transformed into heat instead of being "lost."

In the last scene, Eddy is faced with overuse and abuse arising from his interaction with his friends. "An expert" *[The teacher acted as the expert in this scene. She assesses the situation and then explains to the students that in order for each of them to achieve their respective task, energy*

was transformed from one form to another and that some of the energy is converted into heat, which explains the "hot" they each felt] stepped in to suggest what Eddy and his friends should do to carefully control the use and to stop the abuse. Once again, the teacher asked prompting questions and the children's responses were written on the charts. *[Though not an intended outcome of this project, eight students indicated that Eddy and his friends would need "food" (or a "drink") to "get back energy," suggesting that they understood the concept of energy sources.]* A total of five scenes were enacted.

Segment 4: What Ideas Did Children Develop?

In this segment, the children revisited the responses they had given in Segment 1, and compared their original ideas with those presented on the charts and those gained from the enactment experience. They discussed these, noting whether their ideas had changed, broadened, or remained the same. After the discussions, the children were asked to respond to the questions again. This was useful as both teacher and children were able to see the extent to which children's understanding of the concepts had developed or changed. It also allowed the teacher to detect any misconceptions that children might still have had and if there was any child/children whose ideas had remained unchanged after the intervention.

Segment 5: Gauging Children's Views and Feelings With Interviews

This segment consisted of short semi-structured interviews with the students. These were conducted one month after the role-play session, and the aim was to discover what knowledge and understandings, as well as the levels of awareness about the topic, had been retained by the students. The interviews were also used to probe the impact that the role-play strategy had on students. Each child was questioned using the following list of interview questions;

1. What science topic did we do using role-play?
2. What were three things you enjoyed in that science topic and why?
3. What is energy?
4. Where does energy come from?

5. What is energy used for?
6. What happens to energy when you use it?
7. Why do you think it is important to use energy wisely [the term *wisely* was explained to the children to mean conservatively]?
8. Which character in the role-play impressed you the most and why?
9. If you had to choose a character to be, which one would you choose and why?

The interviews lasted about 15 minutes, as sufficient time was given for all children to collect their thoughts and to respond completely. Some children had to be prompted to get the responses focused on what the question was asking. The anticipated outcome in this segment was two-fold; firstly, to gauge students' conceptual understandings about energy and its usage one month after the role-play strategy, essentially through the first six questions asked in this segment; and secondly, by way of the final three questions, to gauge students' feelings/views about energy conservation and energy conservation practices. Conceptual understandings revealed orally during the interviews were compared to those obtained from students' written responses in Segment 1, in order to determine whether students' original ideas/understandings had broadened, changed, or remained the same.

The interviews were all tape-recorded and subsequently transcribed and coded for analysis.

Outcomes — The Findings

Data were obtained from all 29 children, as there were no absences during the course of the project. Children had a variety of ideas before the role-play but, generally, did not display great concern for the controlled consumption of energy or any great awareness of energy conservation practices. When questioned after the role-play, using the questions asked in Segment 5 [which emerged from Segment 1], it was found that many children had either gained new ideas/understandings leading to a change in their original ideas, or that their original idea/s had broadened to reflect "more scientifically correct" understandings and explanations. For four of the children, there were no changes in their

original ideas after the role-play. Of these four children, two of them knew quite a lot about forms and uses of energy and were aware of the need for conservation, so that their ideas at the end of the project were very much what they came into the project with. These two students, however, indicated how enjoyable and exciting the role-play experience was for them [when interviewed in Segment 5].

The two other students knew very little about energy in the scientific context, but they had what might be described as a religious/cultural perception that energy was used to "do things" and "to live," and that energy was "given to us by God." During the course of the project, they participated in the role-play strategy and they volunteered responses on occasion, thus giving the impression that they were developing "new scientific understandings" of energy and its related concepts. Despite this perceived new learning, which seemed to have run parallel with their "cultural views," their responses to the questions at the end of Segment 5 of the project indicated that it was their cultural understandings/beliefs that were the preferred responses [e.g., "energy comes from God"] given to the questions.

The following acronyms were used to label the impact [if any] that role-play had on students' ideas:

GNIAP — Gained New Idea After Play

IBAP — Idea Broadened After Play

IRSAP — Idea Remained the Same After Play

Table 2 is a qualitative table that shows some of the students' responses before (Segment 1) and after (Segment 5) the role-play intervention, in support of the impacts—GNIAP, IBAP, and IRSAP.

Table 3 further summarizes the outcomes obtained in respect of the change in ideas expressed by each student for questions 3, 4, 5, and 6 (Segment1 compared with Segment 5) after the role-play intervention.

Table 2. Some Students' Responses in Support of Each Impact

Impact	Segment 1	Segment 5
GNIAP	"energy disappears when used"	"energy is converted to different forms to do work … in the end it changes to heat energy"
IBAP	"energy is fuel"	"energy is the ability to do work"
IRSAP	"energy comes from God" "energy is needed to do all work"	"God provides energy for us to live" "energy is needed to do work"

Table 3. Students' Understandings After the Role-Play

Student	Q 3	Q 4	Q 5	Q 6
S1	GNIAP	IBAP	IBAP	IBAP
S2	GNIAP	IBAP	GNIAP	GNIAP
S3	GNIAP	IBAP	IBAP	IBAP
S4	IBAP	IBAP	IBAP	IBAP
S5	IBAP	IBAP	IBAP	IBAP
S6	IRSAP	IRSAP	IRSAP	IRSAP
S7	GNIAP	IBAP	IBAP	IBAP
S8	IBAP	IBAP	IBAP	IBAP
S9	GHIAP	GNIAP	GNIAP	GNIAP
S10	GNIAP	IBAP	IBAP	GNIAP
S11	IBAP	IRSAP	IRSAP	IRSAP
S12	IBAP	IBAP	IBAP	IBAP
S13	IBAP	IBAP	IBAP	IBAP
S14	GNIAP	IBAP	GNIAP	GNIAP
S15	GNIAP	IBAP	GNIAP	GNIAP
S16	IBAP	GNIAP	IRSAP	IRSAP
S17	IBAP	IBAP	IBAP	IBAP
S18	GNIAP	IBAP	GNIAP	GNIAP
S19	IRSAP	IBAP	IBAP	IBAP
S20	IBAP	GNIAP	IBAP	GNIAP
S21	GNIAP	GNIAP	GNIAP	GNIAP
S22	GNIAP	IBAP	IBAP	GNIAP
S23	GNIAP	GNIAP	GMIAP	GNIAP
S24	GNIAP	GNIAP	GNIAP	GNIAP
S25	GNIAP	IBAP	IBAP	IBAP
S26	IBAP	GNIAP	GNIAP	GNIAP
S27	GNIAP	GNIAP	GNIAP	GNIAP
S28	IRSAP	IBAP	IBAP	IBAP
S29	GNIAP	IRSAP	IRSAP	IRSAP

Table 4 is a translation of Table 3, which depicts the respective percentages of the class in response to each of the four questions asked.

Table 4. Students' Understandings After the Role-Play (in percentages)

Ideas	% GNIAP	% IBAP	% IRSAP
What is energy?	55%	35%	10%
Where does energy come from?	28%	62%	10%
What is energy used for?	34%	52%	14%
What happens to energy when it is used?	45%	41%	14%

What is Energy?

Responses like "it make[s] me run" and "it make[s] things move," given before the role-play, suggested that many students believed that energy was a concept associated with motion.

In looking at the responses given by the students after the role-play, it was clear that the role-play exercise increased the understandings of 90% of the students, either by giving them new insight (55%) or by broadening the understanding they already had (35%). At the end of Segment 5, many responded to this question by saying things like "you must have energy to do work," "energy is stored in high things," and "electricity is a kind of energy."

Where Does Energy Come From?

Twenty-eight percent of the students were uncertain as to the various sources of energy and their understandings developed only after the role-play exercise, while 62% of them had some ideas such as energy coming from "food" and from "the sun," which were broadened, so that the

responses given in Segment 5 of the project included many of the traditional fossil fuel sources like coal, gasoline, and oil, as well as "food" and "the sun," as the following interview segment illustrates:

Interviewer: *"Can you tell me where energy comes from?"*

Student: *"Energy comes from the sun, the food we eat and the gas in the car…"*

Interviewer: *"Can you think of or remember any other sources of energy?"*

Student: *"In the play we learn that energy come from fossil fuels which is like crude oil…"*

What is Energy Used For?

Before the role-play exercise, just over half of the students surveyed (52%) had some ideas [as gleaned from their actual responses] about what energy was used for. However, their ideas were broadened after the exercise. On the other hand, 34% of the students had very little idea [no responses given before the role-play] about specific tasks or activities that energy was needed for. However, they evidently gained new knowledge/understandings in this regard after experiencing learning through role-play, as they were able to identify actual situations in their everyday life where energy was used to get a task or activity completed. The following interview segment illustrates this point:

Interviewer: *"Can you give me some examples of what energy is used for?"*

Students: *"Energy is used to do work around the house … and to move things…"*

Interviewer: *"What do you use energy for?"*

Students: *"…to ride my bike …to play cricket … and to dance…"*

What Happens to Energy When It Is Used?

Responses to this question given in Segment 1 of the project indicated that 45% of the students surveyed had misconceptions about what happens to energy when it is used. Some of these misconceptions were conveyed in responses such as "energy disappears" and that when energy

is used it is "lost." An almost equal number of students (41%) had some idea—which was captured in responses such as "it goes into the thing"—about what happens to energy when it is used. At the end of Segment 5, those with misconceptions had most of these "corrected" through the acquisition of new ideas, and those with some initial ideas had these broadened, as could be gleaned from responses such as "…energy is change to other forms…" and "…most times it turns to heat in the end…."

How Do You Feel About Energy That is Wasted?

With respect to their views about energy conservation practices, which was the focus of the last three questions in Segment 5 of the project, the data obtained from the taped interviews conducted one month after the project indicated that most students realized that energy conservation practices were important considerations when using energy. Students' responses were transcribed and grouped into several categories based on the messages communicated by the individual responses. The categories were reviewed several times to ensure that the category label reflected the ideas being conveyed in the truest sense. Similar categories were then grouped together and an overarching theme assigned to each group.

Three prominent themes emerged from the data collected in response to the question "Why do you think it is important use energy wisely?" They were: "securing energy for future generations," "it is not good to waste," and "energy will be depleted very soon if wasted." These themes suggested that students understood the importance of using energy conservatively. Responses obtained from two students could not be coded into any of these categories and the intention was to analyse these on their own merit. Just fewer than half of the class had the view that energy wastage is not a good thing and, therefore, that it was important to use energy conservatively. The numbers of students responding in each theme as well as actual verbatim responses given by some of the students are shown in Table 5.

Table 5. Emerging Themes of Students' Views on the Need to Conserve Energy

Emerging Theme	No. Students Responding	Verbatim Responses
Securing energy for future generations	8	"…[we] need to save for the future…" "…save for later on…" "…keep some for later…" "…other people …later…will need energy…"
It is not good to waste	13	"…do not waste it…" "Wasting energy ….is not good…" "… do not waste …use energy careful[ly]"
Energy will be depleted very soon if wasted	6	"…if we waste it will done…" "…it will finish …one day…" "…what we go do when it gone through…" "One day it will end" "…it will end soon…"
None of the above	2	

As suggested from the verbatim responses, it was clear that most of the students emerged from the project with the understanding that energy was a valuable commodity and that it was worth conserving energy for future generations. In their explanations, students indicated that "careful use" meant things like turning off the fan (or AC unit) and opening the windows on a hot day, or hanging clothes outside to dry instead of using an electric clothes dryer on hot days. Their ideas of not wasting were indicated in responses such as not wasting food, not leaving the lights on if you are not in a room, and not leaving the refrigerator door open for long periods. Some students indicated that turning the television [and radio] off were ways of "saving" energy. Generally, their responses suggested that conserving energy meant using less in all instances. The

idea of alternate sources of energy, for example, solar or wind instead of electrical, was not explicitly expressed by any of the students, but some seemed to have an implicit understanding that was captured in responses such as hanging clothes outside to dry instead of using an electric dryer.

Benefits

As reported by Aubusson et. al. (1997), perhaps the most notable benefit of using role-play to teach energy-related concepts in this project was that students' alternative ideas were clarified, either through a broadening of prior understandings or by the development of new, "scientifically correct" understandings. The interaction during the role-play also allowed for students to make meaningful linkages among several related concepts such as sources of energy, forms of energy, uses of energy, and transformations of energy. With respect to transformations of energy, in particular, students developed clearer understandings about the transformation process in the first instance, but more importantly about the nature of the different forms of energy at each step of the transformation process. The use of common everyday situations in the scenes allowed students to see the relevance of the learning and the ways in which their understandings could be applied to familiar situations in their life. This is similar to the argument put forward by Kofoed (2006) that role-play not only develops students' subject competencies, but that it helps to make them more "competent consumers" of life.

Though it was not intentional in the conceptualization of the project, the interactions and the questions led students to an appreciation of the law of conservation of energy, so many of them came to the realization that energy could not be created or destroyed, but that it is simply converted from one form to another. Linked to this learning, the project revealed that students became aware of the need to conserve energy, either simply to prevent wastage or to preserve supplies for future generations. Students' sense of personal responsibility, in terms of their indication to adopt various energy conservation practices, seems to be a significant benefit emerging from this project.

Challenges

Among the challenges faced during the course of this project was gauging students' prior knowledge. The responses obtained from Segment 1 were helpful to the extent that the specific understanding/s conveyed by them were, in fact, a true reflection of the students' actual understanding at the time. Getting students to physically participate in the "acting" was a challenge, but only for the first two scenes. By the third scene students had become more enthused and much less shy. There were a few instances in Scenes 3 and 4 when the acting was not in exact synchronization [in terms of the scientific concepts and understanding conveyed] with the intended roles of the actors, and it became necessary for the teacher to intervene on a few occasions to get students to focus on their roles. Furthermore, at times students became so involved in the drama that it was necessary for the teacher to explicitly make the link between the drama and the learning. The charts on the wall for each scene were very helpful in this regard. One of the greatest challenges encountered in this project was getting students to articulate their feelings [about energy conservation] in Segment 5. It was clear that this was not a kind of thinking that they were familiar with—it seemed to be an issue to which not much consideration was given. Most of the students thought at length before answering, and the tone of their voices as well as their facial expressions suggested that they were responding with some degree of uncertainty. Of course, the diverse levels of literacy among the students also presented a challenge, but this was minor in comparison to some of the others and was well aided by tape-recording the interviews. Inclusive of pre-planning and debriefing, the project ran throughout the term and so there was no additional time to probe into ambiguous aspects of the findings; for example, to delve deeper into the understandings of the two students who seemed to have a cultural/religious perception or understanding/view about energy.

Conclusion

This project revealed that role-play is an effective way to engage students in science learning at the primary school level, but it must be carefully planned and diligently implemented to achieve meaningful learning outcomes. It is truly a strategy that puts the students at the centre of the learning process and transforms the teacher into a facilitator or

guide. In the present context, teachers do not naturally see themselves in these "new" roles, and so any shift towards this method of teaching will prove to be challenging for teachers in the first instance. The implication, therefore, is that teachers will have to be trained and/or retrained in ways of implementing strategies of this type in their classrooms. At the personal level, there is the further suggestion that teachers would need to be creative and innovative when choosing this teaching/learning strategy to effect learning in their classrooms.

This particular project revealed that the group of students surveyed had a range of ideas coming into the project [before the role-play intervention], and that is was important for the researcher to note these and to use some of these in preparing the scenes to take students from the known to the unknown. The strategy allowed many students to either broaden their old ideas or to develop new ideas. Many of the students shared their new understandings in a variety of ways [as gauged by the interviews conducted one month later], most of which were in line with conventional science ideas.

The major findings at the end of this project may be summarized as follows:

1. 90% of the students had a scientifically sound understanding of what is energy.
2. 90% of the students could identify at least three different sources of energy.
3. 86% of the students could suggest at least five different situations of energy being used.
4. 86% of the students were able to satisfactorily explain what happens to energy when it is used, suggesting in all cases that it is transformed from one form to another.
5. 93% of the students expressed an appreciation for the need to conserve energy, most of them suggesting that wastefulness in not a good habit and others suggesting that it is important to conserve energy for future generations.

Discussion

It is important to remember that this project was conducted in one school with one group of students and, therefore, aspects of the findings cannot

be generalized across all primary schools or even at different levels in the same school. It is unfortunate, however, that the role-play sessions were not video-taped or audio-taped. This was as oversight on the part of the researcher, the shortcomings of which were only recognized late in the data analysis phase of the work. The overarching aim was to gauge the impact of role-play on science learning for a chosen topic, and towards this end the project yielded a positive outcome. In respect of the affective benefits, the findings here are similar to those reported by Bonnet (2000), in that the strategy facilitated a considerable degree of social interaction and bonding among the students of the class. Furthermore, it effectively captured students' attention and stimulated their imagination, as was reflected in the intense levels of dramatization observed in each of the scenes enacted, similar to the experiences reported by Dallman-Jones (1994).

This project offers possibilities for further work, for example, the impact of the strategy on students' learning at other levels of the education system such as infants, and possibly at secondary school as well. It will be interesting to see what the findings at various levels of the education system will reveal. Furthermore, the versatility of the strategy makes it adaptable to a range of science topics, and it will be useful to identify topics in which the strategy might be most effective as a teaching/learning tool.

An emerging question, however, is how do we encourage or motivate science teachers to use role-play strategies in their science teaching? While this project did not probe into the teachers' views and feelings about the strategy [apart from an articulation of the benefits observed and the challenges encountered], it might be useful to explore these in another aspect of this study, in order to understand the issues that interplay in the teacher's domain. This might be an excellent topic for further research.

References

Aubusson, P., Fogwill, S., Barr, R., & Perkovic, L. (1997). What happens when students do simulation-role-play in science. *Research in Science Education*, *27*(4), 565–579.

Banister, F., & Ryan, C. (2001). Developing science concepts through story-telling. *School Science Review*, *83*(302), 75–83.

Bonnet, C. (2000). The relevance of role playing in environmental education. *Proceedings of the International Union of Biological Sciences Commission for Biological Education (IUBS-CBE): International Symposium on Biological Education, IUFM Versailles, Centre de Cergy, France, 15-18 May, 2000*. Available at: http://intl.concord.org/cbe/pdf/bonnet.pdf

Craven, J. A., & Penick, J. E. (2001). Preparing new teachers to teach science: The role of the science teacher educator. *Electronic Journal of Science Education, 6*(1). Retrieved from http://unr.edu/homepage/crowther/ ejse/ejsev6n1.html

Dallman-Jones, A. S. (1994). *The expert educator*. Fond Du Lac, WI: Three Blue Herons Publishing.

Francis, P. J., & Byrne, A. P. (1999). Use of role-play exercises in teaching undergraduate astronomy and physics. *Publications of the Astronomical Society of Australia*, 206–211.

Goldring, H., & Osborne, J. (1994). Students' difficulties with energy and related concepts. *Physics Education*, *29*(1), 26–32.

Graber, W., Nentwig, P., Becker, H-J., Sumfleth, E., Pitton, A., Wollweber, K., & Jorde, D. (2001). Scientific literacy: From theory to practice. In H. Behrendt, H. Dahncke, R. Duit, W. Graber, M. Komorek, A. Kross, & P. Reiska (Eds.), *Research in science education – Past, present and future* (pp. 61–70). Dordrecht: Kluwer Academic.

Haury, D. L., & Rillero, P. (1994). *Perspectives of hands-on science teaching*. Columbus, OH: ERIC Clearinghouse for Science, Mathematics and Environmental Education.

Kofoed, M. H. (2006). The Hiroshima and Nagasaki bombs: Role-play and students' interest in physics. *Physics Education, 41*(6), 502–507.

Ladrousse, G. P. (1989). *Role play*. Oxford: Oxford University Press.

McSharry, G., & Jones, S. (2000). Role-play in science teaching and learning. *School Science Review*, *82*(298), 73–82

Millar, R. (2002). Thinking about practical work. In S. Amos & R. Boohan (Eds.), *Aspects of teaching secondary science: Perspectives on practice* (pp. 53–59). London: *RoutledgeFalmer*.