Journal of Biological Education
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rjbe20

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Available online: 22 Jul 2011

To cite this article: Susan Gebbels, Jo Hunter, Francis K.E. Nunoo, E. Tagoe & Stewart M. Evans (2011): Schoolchildren's use of poetry and paintings in conveying environmental messages, Journal of Biological Education, DOI:10.1080/00219266.2011.583667

To link to this article: http://dx.doi.org/10.1080/00219266.2011.583667

Research paper

Schoolchildren's use of poetry and paintings in conveying environmental messages

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Pupils aged 12–14 from the University of Ghana Primary and Junior High School conducted studies off the coast adjacent to Accra, including a field visit to explore the effects of climate change on the country's biology, ecology and physical environment. They composed poems and made paintings about the coast and sea as means of conveying their views about climate change. Content analysis of these compositions using a count of word descriptors revealed that particular themes or messages tended to recur in both poems and paintings. Both of them depicted Ghana as a beautiful place that was suffering from the negative impacts of climate change. There were, nevertheless, differences in the ways in which these two art forms were used to convey messages. For example, poems used words to stress the national importance of the seas, their value as assets of God's creation and the need for everyone to work together in order to manage them at sustainable levels. Paintings, on the other hand, used images to identify specific causes of pollution and climate change and to illustrate the uses of the seas. It is argued that the creative arts should play a more significant part in the science curriculum. Not only could they bring science to life in the classroom, but they could provide powerful mechanisms whereby young people communicate their own views on environmental issues to other members of society, especially non-specialists.

Keywords: science education; creative arts; poems; climate change

Introduction

There are many challenges that the natural world faces today; for example, climate change, energy security, pollution of aquatic bodies, and overfishing. Yet, despite much press and media attention the majority of people still only imprecisely understand scientific problems. Evans and Birchenhough (2001) have pointed out that there are few signs of a better-informed public since Holdren and Ehrlich (1971) noted the failure of environmental education in influencing the opinions of politicians and industrialists on environmental issues. Kollmuss and Agyeman (2002) argue that knowledge does not always modify behaviour; some people choose not to act. Another explanation for this perceived lack of understanding is that science is frequently communicated using rather dry, uninteresting methods: the scientific report, the academic conference, and the late-night debate. With technology and science evolving faster than ever before it has never been more important to communicate new ideas and concepts to the public and young people in a meaningful yet lucid way.

Watts (2001) has argued that it is necessary to move beyond the customary curricular constraints within schools. He suggests that school science can be both a scientific and literary experience and highlights the power of poetry in stimulating observation, imagination and emotion in school science. This view is supported by Osbourn's (2006) findings that

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Journal of Biological Education ISSN 0021-9266 print/ISSN 2157-6009 online © 2011 Society of Biology
http://www.informaworld.com
DOI: 10.1080/00219266.2011.583667

children of primary-school age can use scientific images, such as earth as viewed from space, salt crystals under the microscope and thermograms of houses, as inspirations for creative writing and art. Other art forms may also have parts to play. Kempton (2004) recommends the use of paintings and cartoons to teach ethics in science, and Francis (2007) found that drama-based science lessons have positive impacts on both attainment and attitudes in science lessons. Tobin and Elmesky (2005) demonstrated how the principles of wave energy movement could be taught through dance. Edmin (2010, cited in Brown 2010) puts forward the idea that students develop communal relationships and collective identities based on the common experiences expressed in hip-hop culture and that if urban students find their lives portrayed in this culture, it logically follows that teaching science in the context of these expressions could coalesce students' identities around pertinent science experiences in the same way.

The present study explores the possibility that young people have the talent and motivation to use art forms (in this case poems and paintings), to communicate views and information on the environment and biological world to wider audiences. This should include adult audiences because, although there has been an explosion of knowledge in the natural sciences (Ehrlich et al. 1999), several studies have indicated that environmental knowledge of the general public is poor and that their abilities to name even common species is limited (Lucas 1987; Gambro and Switzy 1996; Dixon et al. 2005; Bebbington 2005; Kaplowitz and Levine 2005). In many cases young people's knowledge of current ecological issues far exceeds the knowledge that their parents have (Ballantyne, Fien, and Packer 2001). There is also some evidence to show that they can influence their parents' environmental awareness and actions (Uzzell 1994).

Using the arts to convey environmental messages may be a particularly fruitful line of exploration within the African context because the arts have always been used as means of communicating political or social messages (Romain 2002). Theatre has been especially important. Rwangyezi and Woomer (1995) describe the performing arts as the great books of the African continent. Information was once stored in theatrical styles and disseminated through ceremonies and enacted in songs and stories. This function has evidently diminished in the modern world but there are still many examples in which public performances are used to convey messages on health, agricultural or social issues (Yarrow 1997; *JOICFP News* 2000; Ghosh et al. 2006; Daykin et al. 2008; Heong et al. 2008).

Biology and art both rely on observation and synthesis: taking what is seen and creating something new from it. Society could hardly exist without either, but when they come together cultures are enriched, sometimes in unexpected ways.

The present paper is based on a programme of environmental education, focussing on the effects of climate change on Ghana, in particular the coastal zone of that country. It was taught at the University of Ghana Primary and Junior High School. Pupils took part in a series of workshops based on the topic, visited a range of coastal areas around Accra and took part in a debate. Further, each pupil was asked to: (1) compose a poem; and (2) make a painting as a means of expressing their feelings about the effects of climate change on the coastal environment.

Methods

The teaching programme was taught in English, which is the formal language used in all schools in Ghana, to a single mixed-sex class of 50 12–14-year-olds in October 2009 at the University of Ghana Primary and Junior High School (UGP&JHS). The UGP&JHS was chosen for this programme because of the established links that this school has with Epinay Business and Enterprise School in the UK, where one of the researchers is based. The programme was taught intensively over a 2-week period by two professional marine scientists, one from Ghana (Department of Oceanography and Fisheries, University of Ghana) and one from the UK (Dove Marine Laboratory, Newcastle University). The artwork, drama and poems were taught collaboratively by a teacher from Epinay School and the two class teachers from UGP&JHS. As the programme was being taught as part of the school's curriculum during school hours the pupils were all expected to participate and complete any homework set. Permission to take the students on the field trip was sought from the parents.

Prior to the start of the programme the students had limited knowledge about climate change. They understood the basic concepts and how they were relevant on a global scale but they could not apply this knowledge to local issues. The majority of students were not able to recognise or name correctly commonly landed marine fish (*eg* the Round Sardine, *Sardinella aurita*) or common bird species (*eg* the Little Egret, *Egretta egretta*) that they encountered in the field. Over half had not visited the coast before, despite living 30 minutes away. Many parents and guardians normally refrain from allowing children to visit beaches unaccompanied. Culturally, the diet of Ghanaians usually includes fish as a major source of animal protein and some lessons on biodiversity are taken during science class at basic school. Many of the students were, therefore, expected to have come across some of these species in their studies or in their social life.

The theme of the project was climate change and its probable biological and physical impact on the coastal zone of Ghana. The first session was held in the students' classroom; the researcher from the UK gave a presentation, written jointly by both scientists, about the likely causes of global climate change and how they were affecting Ghana's businesses, and livelihoods of citizens. Emphasis was given to the problems that the native species of flora and fauna would face in the event of sea level rise, erosion, ocean acidification, habitat loss and changes in predator–prey interactions due to species redistribution. For instance, the aforementioned sardine species has its occurrence and abundance determined by the strength of upwelling of seawater and this is driven by a lowering of sea surface temperature (SST). Observed increases in SST have tended in recent years to cause changes in the annual timing of the fish in catches as well as reduced its abundance. Lack of electricity in school resulted in the presentation being printed and distributed to the children. A game consolidated and ended the session.

During session two the students recapped their knowledge from the previous lesson before being divided into seven sub-groups of seven. Each sub-group was allocated a familiar social group that they were asked to represent. Both researchers explained that for the remainder of the project the students had to imagine what it would be like to be the people in their sub-group and to gather evidence as to how climate change could affect them. The students were informed that at the end of the project they would be required to relay this information to rest of the class via a 10-minute presentation and answer any questions that their peers might have.

The social groups that the children were asked to represent included: fisherfolk, environmentalists, social sceptics (who did not believe climate change was happening), farmers, community leaders, business owners and scientists. Each group was presented with a file that contained basic information about the probable causes and effects of climate change on the earth and specific information about how it was likely to affect the social groups that the pupils had been given. This included newspaper articles, interviews, case studies and photographs. For example, the business leaders' file contained information about how erratic rainfall patterns in Ghana had led to water levels in the country's main power generation reservoir, Akosombo dam, being dangerously low, which was affecting the efficiency of the hydroelectric dam, which in turn was affecting the country's electricity supply and, therefore, their businesses.

A researcher or class teacher/assistant helped the students consider the problems that their sub-group were facing but they were instructed to allow the pupils to lead the dialogue. Two master's students from the Department of Oceanography & Fisheries of the University of Ghana were also present to assist with the class. During a whole-day field trip the class visited a range of habitats around the coast of Accra to be exposed to potential effects of climate change at first hand.

The students visited Tema harbour, which is one of the largest artificially constructed ports in western Africa. It handles freight and cargo vessels from all over the world. The harbour provides mostly unskilled casual jobs to an enormous human population, most of which lives in squalor and abject poverty in shanty homes that surround the harbour. There is a huge fishing port where fish can be bought wholesale from stalls lining the water's edge. In the canoe basin, up to 500 traditional wooden dug-out canoes can be seen that form the basis of the region's artisanal fishery. These canoes land predominately sardine, mackerel, shrimps, and anchovies. The offshore industrial fleet target, among others, Skipjack (*Katsuwonus pelamis*), Grouper (*Epinephelus aeneus*) and Red Snapper (*Lutjanus fulgens*). The students discussed how warming of the seas could change the distribution of the native fish species and disrupt the prey that they traditionally feed on. The welfare, housing and health of the fisherfolk were discussed, as the pupils were surprised to see the conditions in which many fishing families lived. Several miles along the coast there is an inland brackish water body, Sakumo II Lagoon, an internationally protected RAMSAR site noted for its high biological productivity. The size of the open lagoon varies from 100–350 ha depending on the season. The lagoon is separated from the sea by a narrow sand-dune, on which the Accra–Tema road is built, and is connected to the sea by a small, (permanently open) sluice, constructed to prevent flooding of the coastal road. Large portions of the lagoon dry up in the dry season, resulting in hypersaline conditions. The flood-plain is periodically inundated and the flooded areas are largely devoid of vegetation. There are also areas of freshwater marsh and coastal savannah grassland, the latter composed mainly of *Sesuvium portulacastrum* with various grass species associations.

Seventy species of waterbirds have been recorded at the site, with estimated maximum numbers of some 30,000 birds. Other common species include: Western Reef Heron (*Egretta gularis*), the Common Pratincole (*Glareola pratincola*), Ringed plover (*Charadrius hiaticula*) and Common Tern (*Sterna hirundo*). Breeding waterbirds include: Kittlitz's plover (*Charadrius pecuarius*) and Little Tern (*Sterna albifrons*). Three species of marine turtle: Olive Ridley Sea Turtle (*Lepidochelys olivacea*), Green Turtle (*Chelonia mydas*) and Leatherback Sea Turtle (*Dermochelys coriacea*) have been recorded nesting on the beaches eastern to the site.

The Ghanaian researcher helped the pupils identify the wading birds present and explained how the area's fish stocks are preserved by the implementation of sensitive traditional management practices. The road opposite the lagoon is under threat from coastal erosion, large boulders have been deployed to protect the highway but these have been damaged because the seas are breaking through. This is a problem that is common along Ghana's coast and one which community leaders are concerned about, especially when it is coupled with sea-level rise. One town, Ada, has been reduced to a rapidly disappearing strip of land.

Avicennia germinans and *Rhizophora racemosa* were two of the principal species present at a coastal mangrove swamp visited. The Ghanaian researcher explained the potential effects climate change could have on Ghanaian mangrove forests. Pernetta (2003) argues that present rates of sea-level rise are responsible for loss of mangrove systems. This is of concern as mangrove forests have many uses. They are important supplies of natural renewable resources such as firewood, dyes, poisons, food and construction materials; they provide nursery areas for offshore, commercial species of fish and prawns, sediment traps for land accretion and coastal protection from tidal erosion and storm surges. In addition they serve as habitats and refuge for a large number of species of conservation concern. These swamps paradoxically line a beach of expensive, but low-lying, western-style hotels which are also under threat from sea-level rise. The final field site destination was at the highly polluted Korle Lagoon, an area of the coast where raw sewage from the country's capital is dumped into the sea.

Both researchers led a brief plenary session back in the classroom to consolidate the day's teaching. The pupils were asked to compose a poem for homework to express their individual views on climate change and the probable impact on Ghana. They were asked:

- To write in English
- To write no more than 500 words
- To complete the task in a maximum of 2 days
- To use the information gained during the project for information and inspiration.

The following day the teacher from Epinay School in the UK led a 2-hour art session supported by the two class teachers. The researcher provided children with coloured felt-tip pens, coloured pencils and chalks, water colours, brushes and A3 coloured card in pastel and bright tones. Pupils were told:

- To compose a picture that illustrated the possible consequences of climate change on the biological, social and physical features of Ghana.
- To think about the colours and images that they saw during the field trip.
- That they could use any of the resources made available to them.
- To give the picture a suitable title.

Table 1. Pupils' views of the main features of their paintings, and words that most aptly describe the painting

What are the main features of the picture?	Times quoted	Which words are represented in the picture?	Times quoted
Pollution	34	Pollution	43
Climate change	19	Degradation	30
Sea level rise	1	God's creation	23
Other	5	Animals/plants	19
		Source of food	16
		Beauty	14
		Shipwrecks	13
		Vastness	12
		Enjoyment	4
		National pride	2

Table 2. Descriptors that were identified in poems

Positive descriptors	Descriptors with religious, national or global meanings
Beautiful	Africa
Bright	Creation
Enjoy	Ghana
Happily	God
Lovely	Godliness
Wonderful	Motherland
	Nation
	World
Negative descriptors	Descriptors that attributed responsibilities to particular groups of people
Bad	Citizens
Damage	Family
Danger	Government
Defaecate	Industry
Destroy	People
Dirty	President
Disease	Descriptors that recommended particular actions with regards to the environment
Dump	Awake
Filth	Clean
Harmful	Protect
Health	Save
Litter	Stop
Pollute	Tell
Refuse	Inform
Rubbish	
Shame	
Sick	
Spoil	
Urinate	
Waste	

Table 3. The most commonly occurring descriptors in poems

Descriptor	% poems in which they are used
Positive descriptors	
Beautiful	20.8
Negative descriptors	
Defaecate	10. 4
Destroy	25. 0
Dirty	14.6
Litter	18.8
Pollute	31.3
Descriptors with religious, national or global meanings	
Creation	16.7
Ghana	50.0
God	22.9
World	43.8
Descriptors that attributed responsibilities to particular groups of people	
Citizens	25.0
Family	14.6
President	10.4
Descriptors that recommended particular environmental actions	
Clean	31.3
Stop	43.8

Directly after the art session 47 pupils (all those present) were interviewed on one-to-one basis and asked two questions: 'What are the main features of the picture?' and 'Which words are represented in the picture?' (Table 1). The interviews were held in a separate classroom and undertaken by the English researcher and teacher. The responses were not audio recorded but noted on paper. The pupils were asked to self-generate words used in the responses but this was not a vocabulary test as they were words that had been discussed and used repeatedly in context during the entire teaching programme. They were asked to use a single word in responding to the former question but could use as many as they wished in responding to the latter question. Paintings and poems were used in this teaching programme because they were a means of communication that the students could relate to and they utilised skills that they already had. The art works could easily be produced in a confined space and the poems could be attempted at home. When the paintings were dry they were mounted on backing card and displayed on boards. This was a novel concept for the Ghanaian children who were not used to their work being on show. The walls of their classrooms are completely bare. The display boards were placed outside in the school grounds so that the whole school, visitors and parents could view the art. The pictures were photographed individually for analysis in the UK.

A debate was held in the final teaching session, during which each sub-group gave a presentation about how their social group would be affected by climate change. The pupils read out their poems to the class; some pupils sang or rapped their prose – these were not discounted from the analysis. Six were chosen to be read out in a whole-school assembly the next day.

The assembly was held outdoors, the whole school attended along with all the researchers, and master's students. The University of Ghana's Dean of Faculty of Science was the guest speaker. Two children gave an overview of the teaching programme and six pupils read out their poems. The local press covered the story and articles appeared in two papers: a national publicly owned newspaper, *The Ghanaian Times*; and a popular privately owned newspaper, *New Crusading Guide*. This coverage allowed the children's messages to reach an even larger audience.

When the researchers returned to the UK, all the poems and paintings were subjected to content analysis. None of the paintings were unable to be analysed. Two researchers coded 47 paintings and 45 poems, each researcher checked the accuracy of the other's work by double checking their results. Poems were scanned for the use of words that conveyed specific messages, referred to as descriptors. This approach has been used successfully used in a range

Table 4. The relative use of descriptors in each of the five categories

Descriptor	No. recorded	No. poems including descriptors	% poems including descriptors	Total no. times descriptors used	Mean times descriptors used per poem (± SE)
Positive	6	19	39.6	39	0.58 ± 0.15
Negative	20	40	83.3	117	2.44 ± 0.30
Religious/ national/global	8	42	87.5	117	2.44 ± 0.25
Responsibility	6	19	39.6	39	0.81 ± 0.20
Action	6	34	70.8	74	1.60 ± 0.23

Table 5. Images included in paintings

Image	*n*	%
Uses of the sea		
Fishing	11	22
Boating	14	28
Washing	5	10
Swimming	3	6
Positive descriptors		
Living palms	16	32
Trees (not palms)	22	44
Fish	22	44
Birds	19	38
Flowers	3	6
Negative descriptors		
Defaecation	7	14
Urination	12	24
Lorry discharging effluents	9	18
Factory effluents	10	20
Litter	10	20
Dead palms	9	18
Dead trees (not palms)	3	6

of disciplines including medicine (Taylor, Reed, and Berenbaum 1994), and literature (Stirman and Pennebaker 2001). Reiss, Boulter, and Tunnicliffe (2007) analysed children's drawings to discover how young people see the natural world.

In the case of poems, descriptors were words of five different kinds (Table 2):

- Positive descriptors, such as beauty or enjoyment, which conveyed positive images of the marine or coastal environment
- Negative descriptors, such as pollution or degradation, which conveyed negative images
- Descriptors with religious, national or global meanings
- Descriptors which attributed environmental responsibilities to particular groups of people
- Descriptors which recommended particular actions with regards to the environment.

These descriptors were chosen because of the frequency that they appeared in the poems. No words were used that did not fit the descriptors. The number of descriptors per category was counted, as were the number of poems including the descriptors, the total number of times that the descriptors were used and the mean times that the descriptors were used per poem (Table 4). To overcome the concern that content analysis can show a bias on context, the phrasing in the poems was checked for any oxymoron that could occur. However, none were found.

Words were sometimes used in different forms. This was the case, for example, in using descriptors, such as pollute, pollution and polluted, or beauty and beautiful. These forms were regarded as the same word in the content analyses.

In the case of paintings, descriptors were images within the painting. Both positive (wildlife) and negative (agents causing pollution) descriptors (images) were identified. As in the poems, descriptors were based on the frequency that they appeared (Table 6). Images were also used to convey uses of the seas (*eg* boating). Since use of colour was feasible, attention was given to the use of colours used for the sea, sand, clouds, sky and sun. Analyses of both poems and paintings focussed on content. Literary or artistic merits were ignored.

Results

Both poems and paintings included clear environmental messages. Poems were relatively short. The mean length was 73.12 ± 0.29 words; range 33–149 words. Poems normally used a range of

Table 6. The use of colour for images included in the paintings

	Coloured image included in painting									
	Sea		Sand		Clouds		Sky		Sun	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Occurrence of image	50	100	25	50	32	64	11	22	44	88
Colour used										
Black	12	24	6	24	5	16	0	0	0	0
Brown	0	0	17	68	1	3	0	0	6	14
White	0	0	0	0	2	6	2	18	0	0
Red	3	6	0	0	0	0	0	0	4	9
Yellow	0	0	1	4	0	0	0	0	34	77
Green	9	18	0	0	1	3	0	0	0	0
Blue	26	52	0	0	23	72	9	82	0	0
Purple	0	0	1	4	0	0	0	0	0	0

Figure 1. A painting showing a range of different activities in the coastal zone. The painting includes: lorries discharging effluents; humans defaecating and urinating; living palms on land and fish in the sea; and a person bathing/washing in the sea
Note: that the sand is coloured black.

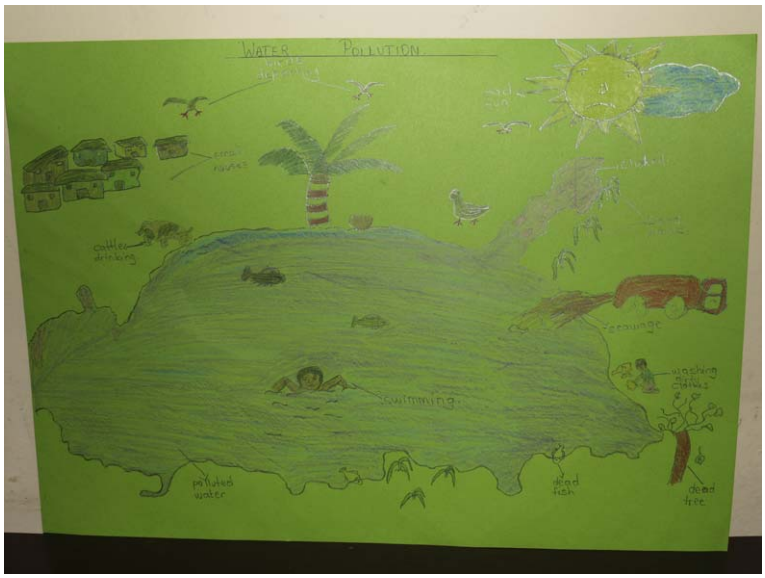

Figure 2. Pressures on the coastal zone. The painting includes: a lorry discharging effluents; living palms, birds and fish; a dead tree and dead fish; one person bathing in the sea and another washing clothes in it; polluted water; a small human habitation; and a choked drainage channel with dead vegetation

descriptors (Table 2) to describe the habitat. Typically, it was described as a valuable place of national importance but one that is being degraded by human activities. Many poems named particular groups of individuals (citizens; family; president) as being responsible for environmental degradation and stated measures that were needed to control it ('stop' polluting; 'clean' the environment).Four of the five categories of descriptors are evident, and have been highlighted, in the following poem *Nature's Beauty* by Lady Dadjo aged 12:

Society needs education

So that it can help the **nation** [religious, national or global category]

To **stop pollution.** [negative category]

The coast has lots to offer

But not to suffer.

This **lovely** treasure [positive category]

We love it for pleasure

Some love it for **beauty** [positive category]

It's nature so keep it

As **God** first intended. [religious, national or global category]

However, there was an imbalance in the use of positive and negative descriptors. Overall, 20 negative descriptors were identified and most poems included several of them (Table 4).

Four of them, especially defaecate, destroy, litter and pollute, were in particularly common use and appeared in more than 10% of poems. The following poem by Abena Anima Osei Berko, aged 12, includes six negative descriptors (destroying, damage, littering, wastes, harmful, bad), although it still concludes with an optimistic message:

Oh! My **God** what is man trying to do.

With our minds thinking that what we're doing is right,

We're rather practising something that is **destroying** our water bodies and causing **damage** to our lands

Global warming and climate change are one thing that is bringing our country's name to shame.

Through our **littering** and our industries throwing their **wastes** into the lagoons and sea.

It is **destroying** our lagoons and seas.

This same situation is causing sea level rise and coral bleaching as well as **harmful** things.

Some **bad diseases** turn out as a result of this **bad** thing we're practising.

So my fellow **Ghanaians** let us put our heads together and reason as one to **stop** practising these **bad** things.

Because **Ghana** we see today will be better tomorrow.

Relatively few positive descriptors were used in the poems (Table 4). 'Beautiful' was the only commonly occurring one of this kind. Nevertheless, many poems created positive images referring to the seas as national assets of global value and of God's creation (see poem by Lady Dadjo earlier).

There was some overlap in the use of descriptors in poems and paintings. Acts, such as defaecation and urination, which reflect the general absence of sanitary facilities for many coastal communities, featured in both paintings and poems (Tables 2, 3 and 6). Nevertheless, images and colour in paintings were used to convey different kinds of messages from those in poems. For example, paintings often illustrated uses of the seas, through images of people boating, fishing, washing and swimming. Images also identified specific causes of environmental degradation, including lorries or factories discharging their effluents into the environment (Figure 1). The consequences of pollution were also depicted by litter on the shore or dead trees and wildlife (Figure 2).

Many paintings recognised the importance of the coast as havens for wildlife and included images of living trees, fish, birds and flowers. The majority of pupils used 'natural' colours in their paintings: blue or green for the sea; brown for sand; and yellow for the sun. However, the sky was usually left uncoloured in which case clouds were usually coloured blue. Most pupils claimed either that they used colour in this way to convey the beauty of the seas or simply to depict them accurately. Black was used as an indicator of degradation, and was commonly used to colour the sea. Black was also used to colour sand and clouds in some paintings. Six pupils used brown to colour the sun. Interviews with students (Question 1) confirmed that these colours had been chosen deliberately to depict a polluted environment. Eighteen of 25 of those using black or brown for the sea, sand or clouds claimed to have use them in this way ($\chi^2 = 7.34$; $P < 0.01$, df = 1). Costall (2001, cited in Reiss, Boulter, and Tynnicliffe 2007) points out that 'Children's use of colour in their drawings is a neglected topic of research'.

Despite the emphasis on climate change in the teaching programme, many pupils (24; 49%) used the term 'pollution' in the titles of their paintings; only 10 of them (20%) included the phrase 'climate change' in the title; 2 included 'sea-level rise' (4%); and 13 used some other form of words (27%). This emphasis on pollution, rather than climate change was also reflected in responses to the questions: 'What are the main features of the picture?' and 'Which words are represented in the picture?' (Table 1).

Discussion

Poems and paintings of Ghanaian schoolchildren contained a range of different environmental messages. Content analysis of both poems and paintings revealed that particular themes or messages tended to recur in them. There were, nevertheless, differences in the ways in which these two art forms were used to convey messages. Both of them depicted Ghana as a beautiful place that is suffering the negative impacts of pollution and habitat degradation, which reflected the current state of the coastal area of Accra. Poems also used words to stress the national importance of the seas, their value as assets of God's creation and

the need for actions, such as everyone working together in order to manage them at sustainable levels. Paintings, on the other hand, used images to identify specific causes of pollution and to illustrate the uses of the seas. For example, the word 'Ghana' was used in 50% of poems but is not depicted in the paintings at all. (The national flag could have been painted.) These differences reflect the creative strengths of each art form and suggest that using at least two approaches enables researchers to gain a greater insight into the children's understanding of the topic. Using a visual and written art form to deliver the message about climate change was a powerful way of disseminating the information to the children's peers and the wider community. Although the poems had negative descriptors in them, Table 4 shows that these were not used as frequently as the sum of all the other more positive descriptors.

There was an emphasis on pollution, rather than climate change in the paintings, probably because pupils had difficulties in creating images of climate change, which is an abstract concept. This could also be a reflection that none of the local Ghanaian languages have as yet a word or phrase accepted as direct translation for climate change. Pupils were consequently reluctant to use the term 'climate change' in their titles of paintings and many of them regarded 'pollution', which is more easily depicted by images, as the major feature of the painting.

Poems and songs are particularly powerful tools of communication to non-specialists because they can convey messages in forms that are far more palatable and persuasive to the general public than a scientific report or a media interview. In part, this is because they can reflect the composer's innermost feelings (Stirman and Pennebaker 2001; Furman et al. 2007) and views in them can be expressed with passion and commitment. Common themes in the compositions produced in the current project are the subjective views of young people who had carried out brief surveys of the coast and, therefore, lack scientific rigour, which is essential in communication between scientists. However, rigour is less important in communication with the general public. Unlike the scientific report, the message(s) within the poem or painting is probably as important as scientific data generated by environmental surveys because the general public can associate with images or language used in their daily lives. Although descriptions of the marine and coastal environments as places of beauty and enjoyment, part of the people's national identity and God's creation may have no part in the standard scientific report, they enrich poems and paintings, bringing the topics under consideration to life. They are probably more effective than reports in generating interest in the conservation cause.

Intergenerational learning, through which young people learn about the environment from parents or other elders in the community (Liu and Kaplan 2006) has probably always played a significant role in enabling young people to learn about the environment. However, while detailed information on the way in which the transfer of knowledge of this kind occurs is lacking, poor environmental and biological knowledge in the adult population (see earlier) suggests that, at least as far as children learning about the natural world from adults is concerned, the influence of intergenerational learning is in decline. This then shifts the onus because young people are likely to be more knowledgeable than their elders on environmental issues. The education process is turned on its head because children have the opportunity to become the educators. Ballantyne, Connell, and Fien (2006) have already stressed that young people have the potential to become teachers of the adult population on environmental issues.

After a week-long programme the children were passionate about the subject of climate change and keen to impart their knowledge to a wider audience. They participated in the class debate with great maturity and good understanding. The pupils offered up some possible solutions to combat the problems surrounding climate change and offered ideas that individuals could act upon, such as energy-saving tips and driving less. The students had gained enough knowledge about the topic to compose provoking poems and paintings that powerfully expressed their views about the subject to their peers and elders.

The increase in the students' biological knowledge was not statistically tested, as it was not part of the aims of this project; however, the children expressed a keen interest in learning more about the flora and fauna of their country. Seeing native species in their natural habitat helped the students understand the complexity of climate change when the inter-connectedness of a whole ecosystem is considered. This was reflected in the children's pictures, they all painted a complete scene; nobody painted isolated events or a single image. This suggests that the children realised that the problem of climate change is one that is complex and that its effects are widespread. Several children said that they wished to take their families to some of the sites that they had visited during the fieldwork.

There is no doubt that young people have the potential to influence environmental attitudes and the behaviour of adults in positive ways (Evans, Gill, and Marchant 1996; Liu and Kaplan 2006; Nunoo and Evans 2007), and the creative arts provide one means by which they can do so. Studies by Ballantyne, Fien, and Packer (2001) and Vaughan et al. (2003) found drama and art to be successful tools in raising paternal awareness of conservation issues in intergenerational learning projects. When science meets art and the two work together, the result can be extraordinarily productive, as gaps in our under-

standing are filled and new ways of expressing problems and communicating with people are established. The arts can be a rather different pair of glasses from which we can understand science but it is a perspective that young people have the power and passion to show us as adults.

References

Ballantyne, R., S. Connell, and J. Fien. 2006. Students as catalysts of environmental change: A framework for researching intergenerational learning through environmental education. *Environmental Education Research* 12: 413–27.

Ballantyne, R., J. Fien, and J. Packer. 2001. School environmental education programme impacts upon student and family learning: A case study analysis. *Environmental Education Research* 7: 23–37.

Bebbington, A. 2005. The ability of 'A' level students to name plants. *Journal of Biological Education* 39: 1–5.

Brown, B. 2010. Hip-hop as a resource for understanding the urban context. *Cultural Studies of Science Education* 5: 521–4.

Daykin, N., J. Orme, D. Evans, D. Salmon, and M. McEachran. 2008. The impact of participation in performing arts on adolescent health and behaviour. *Journal of Health Psychology* 13: 251–64.

Dixon, S.P., A.C. Birchenough, S.M. Evans, and M.P. Quigley. 2005. children's knowledge of birds: How can it be improved and can it be used to conserve wildlife? *Transactions of the Natural History Society of Northumberland and Durham* 64: 121–34.

Ehrlich, P.R., G. Wolff, G.C. Daily, J.B. Hughes, S. Daily, M. Dalton, and L. Goulder. 1999. Knowledge and the environment. *Ecological Economics* 30, no. 2: 267–84.

Evans, S.M., and A.C. Birchenhough. 2001. Community based management of the environment: Lessons from the past, options for the future. *Aquatic Conservation: Marine and Freshwater Ecosystems* 11: 137–4.

Evans, S.M., M.E. Gill, and J. Marchant. 1996. Schoolchildren as educators: The indirect influence of environmental education in schools on parents' attitudes towards the environment. *Journal of Biological Education* 30: 243–8.

Francis, M. 2007. The impact of drama on pupils' learning in science. *School Science Review* 89: 91–102.

Furman, R., C.L. Langer, C.S. Davis, H.P. Gallardo, and S. Kulkarni. 2007. Expressive research and reflective poetry as qualitative enquiry: A study of adolescent identity. *Qualitative Research* 7: 301–15.

Ghosh, S.K., R.R. Patil, S. Tiwari, and A.P. Dash. 2006. A community-based health education programme of bio-environmental control of malaria through folk theatre (Kalajatha) in rural India. *Malaria Journal* 15: 5–123.

Gambro, J.S., and H.N. Switzy. 1996. A national survey of high schools students' environmental knowledge. *The Journal of Environmental Education* 27: 28–33.

Heong, K.L., M.M. Escalada, N.H. Huan, V.H. Ky, L.V. Thiet, and H.V. Chien. 2008. Entertainment-education and rice pest management: A radio soap opera in Vietnam. *Crop Protection* 27: 1392–7.

Holdren, J.P., and P.R. Ehrlich. 1971. *Global ecology: Readings towards a rational strategy for man*. New York: Harcourt Brace Jovanvich.

JOICFP News 2000. Health education leading to community action in Ghana. *JOICFP News* 308: 5.

Kaplowitz, M.D., and R. Levine. 2005. How environmental education measures up at the big ten universities. *Environmental Education Research* 11, no. 2: 143–60.

Kempton, T. 2004. Using paintings and cartoons to teach ethics in science. *School Science Review* 86: 75–82.

Kollmuss, A., and J. Agyeman. 2002. Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research* 8, no. 3: 239–60.

Liu, S.-T., and M.S. Kaplan. 2006. An intergenerational approach for enriching children's environmental attitudes and knowledge. *Applied Environmental Education and Communication* 5: 9–20.

Lucas, A. 1987. Public knowledge of biology. *Journal of Biological Education* 21: 41–5.

Nunoo, F.K.E., and S.M. Evans. 2007. Citizenship in a Ghanaian school: Students' contribution to sustainable management of the coastal environment. *School Science Review* 88: 107–14.

Osbourn, A. 2006. A meeting place: the science, art and writing initiative. *Current Science* 97: 1547–54.

Pernetta, J.C. 2003. *Mangrove forests, climate change and sea level rise: Hydrological influences on community structure and survival with examples from the Indo-West Pacific*. Marine Conservation and Development Report. Gland, Switzerland: IUCN.

Reiss, M., C. Boulter, and S.D. Tunnicliffe. 2007. Seeing the natural world: A tension between pupils' diverse conceptions as revealed by their visual representations and monolithic science lessons. *Visual Communication* 6, no. 1: 99–114.

Romain, K.E. 2002. Traditional dance in Ghana: A means of preserving and re-affirming Ghanaian culture. *African Diaspora ISPs*. Paper 3. http://digitalcollections.sit.edu/african_diaspora_isp/3/

Rwangyezi, S., and P. Woomer. 1995. Promoting environmental awareness through performance education. *Nature & Resources* 31: 34–9.

Stirman, W.S., and J.W. Pennebaker. 2001. Word use in the poetry of suicidal and nonsuicidal poets. *Psychosomatic Medicine* 63: 517–22.

Taylor, M.A., R. Reed, and S. Berenbaum. 1994. Patterns of speech disorders in schizophrenia and mania. *Journal of Mental Disorders* 182: 319–26.

Tobin, K., and R. Elmesky. 2005. Expanding our understandings of urban science education by expanding the roles of students as researchers. *Journal of Research in Science Teaching* 42, no. 7: 807–28.

Uzzell, D. 1994. Education for environmental action in the community: New roles and relationships. *Cambridge Journal of Education* 29: 397–413.

Vaughan, C., J. Gack, H. Soloranzano, and R. Ray. 2003. The effect of environmental education on school children, their parents and community members: A study of intergenerational learning and intercommunity learning. *The Journal of Environmental Education* 34, no. 3: 12–21.

Watts, M. 2001. Science and poetry: Passion v prescription in school science? *International Journal of Science Education* 23: 197–208.

Yarrow, R. 1997. Darpana for development performance and change. The Darpana outreach programme: Performance education and change. *Seagull Theatre Q* 13: 54–61.