The sustainable development of the London 2012 Olympic Park: a real controversy? 11- to 15-year-old students' perspectives right from the scene

Ruth Amos and Helen Robertson

ABSTRACT In the midst of challenges facing school science education in providing students with authentic learning experiences aimed at development of important life skills for future citizens, a project at the London 2012 Olympic Park is providing a unique opportunity for urban field visits in the built environment. The Field Studies Council is bringing science students to the 'View Tube', to engage in fierce debate over whether the Olympic Delivery Authority's claims about '*the most sustainable Olympic Games ever*' stand up to scrutiny. Students have been exploring narrative evidence thoughtfully and, to date, opinions are mixed.

From a recent advertisement for *The Economist* displayed on the London Underground:

Hosting the Olympic Games is not a waste of money.

The games will help the poorest bit of London. Western Europe's biggest shopping centre is being built next to the Park.

A big building project has been a boon to a stumbling economy. More than 20 000 people have worked on the site.

Having a big party in London will clear the place up. That's worth a lot.

Where do you stand?

In December 2009, a small group of educators from the informal learning sector and from higher education and secondary education met in Stratford, east London, at the invitation of Steve Tilling, director of the Field Studies Council (FSC). Our location was a bright green 'classroom' (constructed from old shipping containers) situated on the southern perimeter of a famous building site: the classroom was the View Tube, overlooking the London 2012 Olympic Park (Figure 1).

By the time you read this article, the London 2012 Olympic and Paralympic Games will be just weeks away. Two and a half years ago, the historians and geographers among us were

Figure 1 Changing face of the London 2012 Olympic Park, as seen from the View Tube balcony in (from left to right) April 2010, October 2011 and March 2012

brimming with ideas for interesting fieldwork concerning the creation of the main Olympic venue: archaeological excavations revealing bygone eras, exciting urban regeneration and so forth. We scientists saw magnificent triangular structures in the main stadium (constructed from reused gas pipes) and 'forces in action' aplenty. Inevitable impacts on wildlife and environmental consequences for an area of urban marshland, billed as derelict and in need of redevelopment, made for thought-provoking issues. *The Economist*'s advertisement above reveals typical media attention given to the development of the London 2012 Olympic Games and therefore the pledge by the Olympic Delivery Authority (ODA) to '*deliver the most sustainable Olympic Games ever*' (London 2012, see *Websites*) provided us with a context in which to create a variety of cross-curricular activities.

Learning outside the classroom – contemporary issues

Learning outside the classroom (LoTC) in the UK has been the focus of research and policy debate in recent decades (DfES, 2006; Lock, 2010). While urban science fieldwork is beginning to gain more credibility (Glackin, 2007), busy secondary science teachers in inner-city schools continue to face challenges in accessing fieldwork opportunities 'on their patch'. Fieldwork in urban settings is often considered the domain of humanities subjects, due in part to examination coursework in geography. However, progress is being made. In the March 2012 issue of *SSR*, Glackin and Jones (2012) showcase examples of stimulating science fieldwork in local parks, made possible through collaboration between experts within the informal sector and teachers who act as 'enablers' in school.

To address the provision of authentic fieldwork experiences for inner-city students, the FSC coordinated the London and City Challenge Residential Initiatives, which saw over 34,500 11- to 14-year-old students from London, Manchester and the Midlands travel to field centres across the UK from 2004 to 2010, thereby developing social, affective and cognitive skills (Amos and Reiss, 2012). Curriculum pressures, financial constraints and health and safety issues continue to reduce the frequency with which school students are afforded such experiences. Many science departments no longer run traditional biology field visits (Lock, 2010). Amidst the undoubtedly rich opportunities for human geography and historical 'research', the legacy proposals for the London 2012 Olympic Park also provide potential for some local, authentic science. Local LoTC events can reduce some of the constraints often associated with organising more 'distant' field visits and can open students' eyes to what is happening on their own doorstep (ASE Outdoor Science Working Group, 2011).

Controversial issues surrounding London 2012 – an out-of-classroom SSI about sustainable development

Regeneration of inner cities can give rise to complex and conflicting social, economic and environmental impacts concerned with notions of sustainable development. In the September 2010 special issue of *SSR* on education for sustainable development, Marcus Grace (2010), Justin Dillon (2010) and others noted the continuing challenge for science teachers in attempting to help students make sense of its multiple, controversial definitions, or even to address environmental education within the science curriculum in a meaningful way for future citizens.

We suggest that large-scale building projects such as London 2012 allow teachers to locate the exploration of science-related issues for sustainable development within frameworks for controversial (Levinson, 2008) or socio-scientific issues (SSIs; for example, Sadler and Fowler, 2006). The use of SSIs as authentic learning contexts fits with requirements in the current National Curriculum for science in England at key stage 3 (ages 11–14) for students to '*contribute to discussions about scientific issues*' (DfE, 2011). Moreover, bringing students to a venue such as the View Tube to discuss an SSI *in situ* has the potential to offer much-needed real-world application within the secondary science curriculum (Aikenhead, 2006; Fox, 2006). To develop an engaging activity, we held discussions with site engineers and sought narrative accounts from local business owners, residents and members of the community. Sustainability claims made by the ODA in 2005 underpinned London's bid to host the 2012 Olympic Games. Oppositional concerns about London 2012 registered by Games Monitor in 2006 are a pertinent source of counter-evidence. We generated a number of 'evidence statements' drawing upon data and narrative aimed at revealing some of the main issues to 11- to 15-year-old science students in a transparent way (Box 1).

BOX 1 Evidence statements for supporting argument building

A new 120 metre high wind turbine will generate some of the site's electricity.	The ODA hope 20% of all the energy used in the Olympic Park will be generated from renewable resources.
Radioactive material was found on site; it probably came from an old watch and clock factory.	The radioactive material on site was sealed and buried under one of the bridges, rather than taking it away.
Existing wildlife habitats are at risk from being disturbed by the building work for at least 5 years.	Contractors are moving thousands of newts and hundreds of frogs to new habitats on site during building work.

To encourage science teachers to bring their students to the View Tube amidst the crowds of geographers and tourists, the SSI includes an abundance of scientific and environmental impact data. Clusters of evidence cards (Box 1) can be used to build science narratives lending support to, or detracting from, a positive Olympic legacy. Students have the opportunity to interrogate evidence 'for' or 'against' the sustainable development of London 2012. An activity encompassing multiple perspectives also needs social and economic impacts so the preamble to the activity encourages students not only to consider sustainable development from an 'environmentally friendly' standpoint but also using broader definitions (Box 2). There is, of course, potential for the activity to contribute to cross-curricular work. We are, however, interested here in exploring how students draw upon scientific and environmental evidence.

A collaborative partnership between informal and formal sectors

Our backgrounds as science educator (RA) and field visit leader (HR) afforded fruitful collaboration during the project. Helen has become knowledgeable in all aspects of London 2012 development over the past three years. She and the other FSC tutors in the project fulfil the role of 'expert' for visiting students, giving valuable interaction with a scientifically knowledgeable adult in the real world (Aikenhead, 2006).

During project design, informal and formal learning sectors worked together. The location of the Olympic Park is recognisable on a screenshot from a popular television soap opera, which the FSC team uses to orientate visitors (Figure 2).

Four science teachers and their classes of key stage 3 students contributed to planning and trialling. Ruth acted as the link between schools and FSC London East tutors, as well as structuring the intervention within a framework of action research to ensure critically reflective development. Teachers and students gave invaluable feedback on activity structure, perceived strengths and weaknesses, and research instruments. In this way, we attempted to

BOX 2 The role-play scenario

You are a team of three scientific experts advising on the building of the Olympic Park. The construction is now well under way and you are looking out onto the Olympic site with your colleagues, trying to decide whether the Olympic Delivery Authority (ODA) is committed to sustainable development. Just how environmentally friendly is all the building? Is it really justifiable to spend all that money for an event that will only last about 4 weeks in 2012?

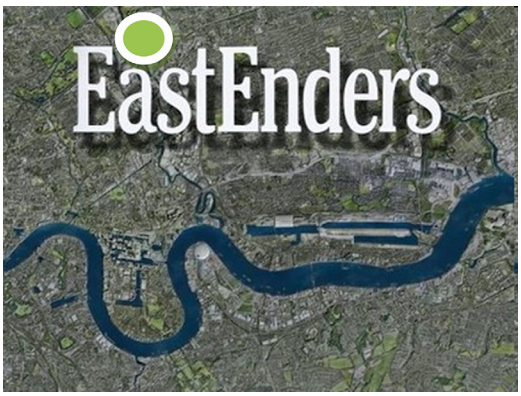


Figure 2 Green marks the spot of the Olympic Park in east London

strengthen the accessibility and true authenticity of the out-of-classroom learning opportunity (Stocklmayer, Rennie and Gilbert, 2010). Reasonable time spans between enactment stages allow for reflective activity development. We used a role-playing scenario (Box 2) to allow students, if they wished, to adopt life-like roles (identities) in an authentic setting. Since 2010, 368 science students (and, increasingly, a number of GCSE Geography students within Olympic-themed coursework for 2012) have taken part in the debate. Typical field visits to the View Tube consist of a two-hour session and, in line with FSC field visit ethos, commence with some 'competitive' team bonding. Students mime 'Olympic charades – guess the Olympic sport' out in the eco-garden at the View Tube (Figure 3). The ensuing collaboration sees students trying to figure out the nuances of 'rhythmic gymnastics' or 'equestrian dressage', which is sufficiently challenging to induce creative thinking in most young people – and their teachers. The warm-up also orientates students to their new learning environment, making possible early observations of the built landscape before them.

Bringing students to the View Tube highlights the value of urban fieldwork in science; moreover, the SSI activity has provided valuable insights into adolescent science students' informal reasoning skills. There is some debate about the age-related ability of young people to engage meaningfully in complex decision-making within SSIs (Kuhn, 2001). The claims 'for' and 'against' the sustainable development of the London 2012 site provide ample opportunity for students to demonstrate higher level evaluative judgement by unpicking evidence and seeking to anticipate counter-arguments. Evaluative judgement is a challenging process and much of the literature suggests the need for high levels of scaffolding by teachers (for example, Simon, Erduran and Osborne, 2006). During the View Tube activity, in the spirit of informal learning, students' thinking

Figure 3 Olympic charades in the View Tube eco-garden

Table 1 Details of schools in the project

School	Sex	Year	Number of students	London borough	Distance from school to Olympic Park (miles)
A	Mixed	9	27	Barking and Dagenham	8.4
B	Girls	9	23	Newham	3.1
C	Mixed	9	21	Haringey	5.6
D	Mixed	9	31	Brent	14.5
E	Mixed	10	27	Brent	15.4
F	Mixed	10	21	Wandsworth	12.2
G	Mixed	9	30	Barking and Dagenham	8.4
H	Girls	8	22	Newham	3.1
I	Mixed	9	26	Brent	16.2
J	Boys	10	28	Barnet	14.5
K	Girls	7	14	Croydon	10.6
L	Mixed	8, 9	18	Newham	2.8
M	Mixed	10	26	Tower Hamlets	2.2
N	Girls	7, 8	30	Lewisham	9.3
O	Mixed	7	24	Waltham Forest	7.6
			Total = 368		**Average = 8.9**

is supported in a relaxed manner. The informal learning environment allows students to engage in independent dialogue and to combine personal ideas about sustainable development with what they see, hear and experience (Levinson, 2008). Teachers support students as they wish during the sessions, and seek opportunities for embedding the event into the school science curriculum.

Methodology

Table 1 shows details of secondary schools (13 state and two independent) taking part in the project up until March 2012. In keeping with sustainable development aims, journeys were made on public transport with distances between school and the View Tube of between just over 2 miles and 16 miles. The extensive public transport system in London allows for a broad definition of 'local' fieldwork setting.

In the current article, we highlight research that explores the following questions:

1. To what extent can an authentic, out-of-classroom SSI activity in an inner-city setting contribute to a school science curriculum?
2. How do urban, adolescent students evaluate evidence they consider scientific or environmental in nature, during an SSI concerning sustainable development at the London 2012 Olympic Park?

Data collection methods were:

- field notes in the form of a researcher reflective journal, including informal discussions and successive planning meetings with FSC tutors, teachers and students;
- pre-visit teacher interviews to elicit teacher requirements and plan specific sessions;
- student environmental disposition questionnaires to elicit personal conceptions of sustainable development at the beginning of the SSI activity, as well as environmental attitudes;
- field notes, photographs and personal observations during the sessions;
- photographic records of students' chosen evidence while developing oppositional positions;
- student- and teacher-made video recordings, made by all teams of three during informal reasoning episodes to capture evaluative judgements;
- post-visit (4–5 weeks) small-group student interviews in school during which outcomes and artefacts from the View Tube activity were explored further;
- post-visit teacher interviews to reflect on activity outcomes and student interview data.

Findings

Urban science fieldwork supporting the school science curriculum

In the early phases of the project, teachers in the main organised visits to the View Tube as 'one-off' events, seeing related links at later points in the school science curriculum in 2012:

We'll be working on sustainable building towards the end of the school year so I'll try to bring the experience in there for them.

Several of the teachers reported planned Olympic events in a range of subjects in 2012. One science department (school H) is running an Olympic lesson in every topic. Physical education departments are naturally setting the pace. Four schools are Olympic partners and will receive tickets for students to attend the Games in July.

Students were unanimously positive about coming to the View Tube. The suggestion that the activity might be successfully run at school was met with vehement disagreement by all interviewees:

My science teacher doesn't know all this stuff like the tutors there do.

Being at the Olympic Park helped us to understand the actual, real situation much better than if we'd been in a boring old school classroom. Seeing pictures isn't the same as seeing it all for real. (Figure 4)

Figure 4 Overlooking the Olympic stadium

The people living there, they made us realise lots of things we didn't know about the building of the Olympics – the allotments going, the people losing their homes ...

Embedding the View Tube experience in the school science curriculum

We examine in more detail here how a teacher, Terese, used the activity as a potential enhancement opportunity for year 9 (ages 13–14) stage 1 BTEC students, (an opportunity noted by Glackin and Jones, 2012).

Terese leads the stage 1 BTEC course in school G and she decided to include the field visit in a coursework component of a unit about natural and human impacts on the environment. Thirty year 9 students from two BTEC classes took part in October 2011. Before the visit, students explored ideas related to sustainable living. The idea was that, after the visit, these students would take back to school all they had learnt about the sustainable development of the Olympic Park to present to their peers.

During the visit, students were visibly excited about being at the Olympic Park; as soon as they rounded the corner from the Docklands Light Railway station, cameras were flashing. The Olympic charades activity was good-natured and several students commented afterwards on the value of the activity as a warm-up, for example:

It was fun and got us thinking about all the Olympic sports. Some are weird.

Once inside, most students from school G readily acknowledged their lack of a good grasp of ideas about sustainable development; most hesitated at length before committing thoughts to paper:

Mikela: *To see is there is enough land to build something?*

Chase: *Is it worth spending all that money on the stadium for 4 weeks?*

Ajay: *Things to do with the environment?*

During the post-interview, the students from school G showed progress with their understanding of sustainable development, agreeing that:

It's all got to be able to last a long time not just for the Olympics.

They felt strongly that the issues were local, more for people living nearby:

It doesn't really affect us here. The Olympics would never come to Dagenham; everyone would put their foot down, they'd never *move for it to be built.*

They were all also able to explain their choice of evidence as well as to recognise when they had not known enough to make judgements:

Chase: *For the negatives, I done about the toxic waste.*

Ruth: *Can you see anything now* [on the eveidence statement cards] *about toxic waste?*

Lacey: *It says that the radioactive was sealed and buried under one of the bridges, instead of taken away.*

Ruth: *Yes; now look at the photos of the evidence you chose on the day ... everyone was putting that down as a negative; so have you studied radioactivity yet at school?*

Lacey: *No we haven't.*

Ruth: *Right, not yet, so apart from here, where have you heard about radioactivity before?*

Chase: *Somewhere earlier in the year ... at a power plant ... it spilt ...*

Lacey: *The only thing I know about it is it's on* The Simpsons*!*

Ajay: *Ah, it was in Japan ...*

Ruth: *Now why do you think the builders of the Park decided to bury the radioactivity instead of taking it away?*

Chase: *In case it spilt, it would be dangerous.*

Ruth: *So is that a good thing or a bad thing?*

Lacey: *I don't know now, I'm in the middle ... I don't really know a lot about it so I can't really decide.*

The subsequent school G science lessons took place 5 weeks after the field visit. Students produced a 'fact file' outlining natural and human impacts on the environment, for example volcanic eruptions and deforestation. The sustainable development of London 2012 became one of the human impact case studies. Once the positive and negative implications of 'events' had been collated, students circulated in a marketplace

peer-teaching forum. Students traversed the marketplace, gathering information from each 'learning stall', where an expert awaited 'customers'.

General outcomes for students at the View Tube

During oppositional dialogue, teams of three students successfully developed arguments 'for' and 'against' the sustainable development of the Olympic Park (Figure 5). The sophistication of adopted strategies varied considerably within groups and across the age range – some were able to only re-read evidence to one another while others deconstructed, evaluated and re-told narratives in opposition to their counterparts' arguments. A section of dialogue by students from school F (A=arguing against; F=arguing for) illustrates these personal interpretations:

F: *20% of the energy for the Olympic Park is going to come from renewable sources.*

A: *Yes but what about the other 80%; that's still coming from fossil fuels so that's not good.*

F: *But 20% renewable energy is so much better than it was in Beijing.*

A: *But that will be four years ago, we should be much better than that by now.*

F: *Now look, if you have 100 000 light bulbs, then 20 000 will be powered by renewable energy, and not just for the Olympics, it will still be there afterwards so that's really good.*

A: *But 80 000 will still be from fossil fuels! And anyway, why have lights at all on the stadium, it should all be done in daylight so lights wouldn't even be needed.*

The role-play scenario was a background feature for most students but several used it effectively to reinforce their points:

There were 500 objections to the Olympics originally … and I was one of them!

The student making this declaration was from a nearby school (school B, just 2 miles away). There was indeed a noticeable 'proximity' effect for these students, as suggested by students from school G, linking legacy outcomes with their local lives:

I'll be really pleased if West Ham [the local football team] *get the stadium afterwards; it's always a nightmare down my road when they're playing.*

Figure 5 Student teams building arguments (Olympic stadium behind)

Fairly unanimously, students built their arguments using a balance of scientific, environmental, social and economic evidence (Figure 6). Emotive and value-laden decision-making was certainly in operation during most argumentation episodes, and students also tended to trust the presented evidence unquestioningly:

Look, it says here that hundreds of frogs and newts have been moved to make way for the Park. That's really disturbing – how would you like it?

However, older students (14- to 15-year-olds) were able to make more evaluative judgements about scientific evidence, as highlighted above.

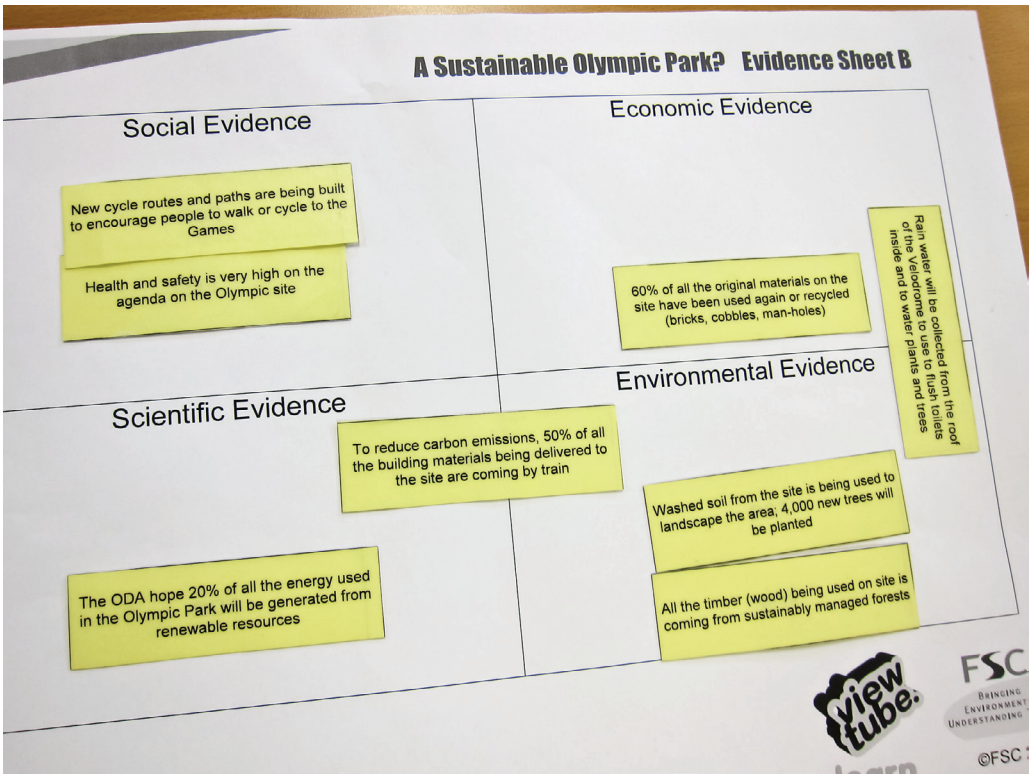
'Is this really science?'

Despite a focus on scientific and environmental evidence concerning sustainable development, teachers and students alike held mixed feelings about whether they were actually 'doing science' at the View Tube. All teachers confirmed that students had participated in small-group discussions about controversial issues in science in key stage 3 (as part of the 'Applications and Implications of Science' curriculum strand; DfE, 2011):

They get about two argumentation activities per topic at KS3. The main purpose is for them to learn skills and process. The ones that work best often have biological contexts like cloning, or perhaps energy sources. I'm not sure we convinced them that sustainable development is interesting!

However, during and after the field visits, several participants declared that the event had seemed: '*more like geography*' or at least '*a mixture of different subjects*'. Students felt that

(a)



(b)

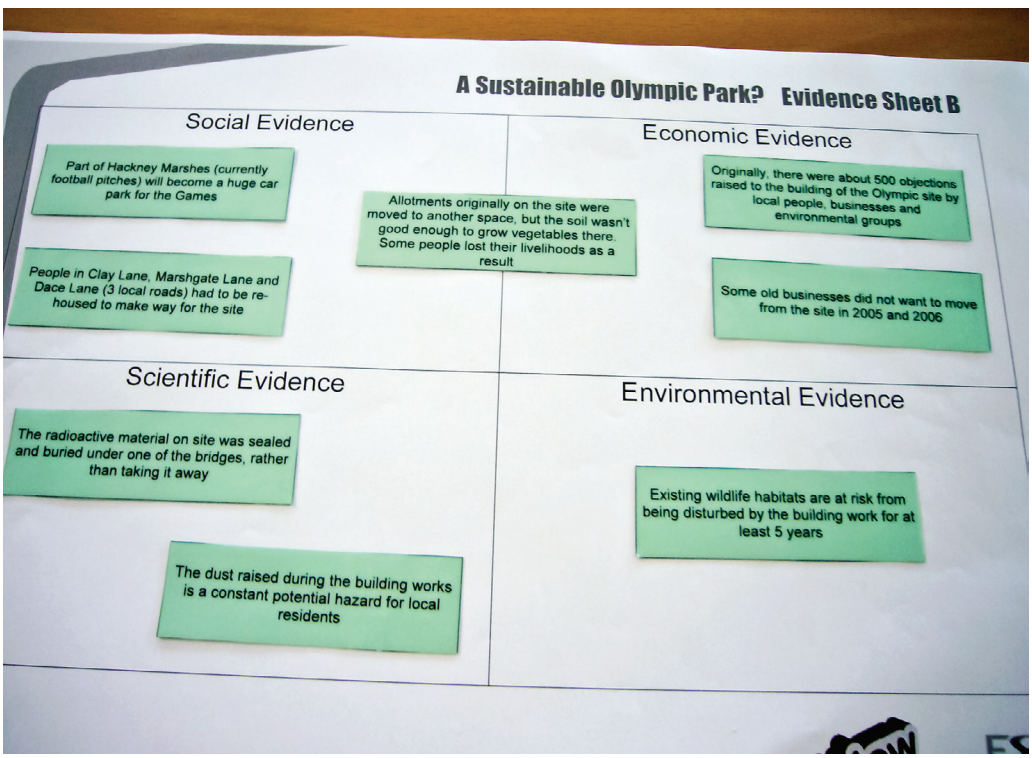


Figure 6 Strong evidence (a) 'for' and (b) 'against' the sustainable development of the Olympic Park

examining evidence was '*more like history*' and there seemed to be a strong sense that science was really '*doing experiments*'. This finding reinforces the continual challenge of signposting the kinds of activity students recognise as 'scientific' in school but, we hope, it also signals important opportunities for cross-curricular approaches to fieldwork and SSIs as a means to learn about global issues (Bourn and Brown, 2011).

On a different note, students from two schools were strongly in favour of a more aesthetically appealing design for the main Olympic stadium:

I can't see myself going there afterwards to look at it. The one in Beijing was much more beautiful. Why couldn't we have had an amazing floating stadium, maybe using electromagnets like those railways in Japan? Now that would have been cool.

Students' notions of sustainable development

Students' definitions of sustainable development in the context of the building of the London 2012 Olympic Park legacy can be summarised as follows (ideas which were deficient even in a time-related sense were few in number):

- simply time-related – '*last for more than its main purpose*';
- human-focused (anthropocentric) – '*will benefit us*';
- environment-focused (bio-centric) – '*nature and Earth's atmosphere are considered important in a plan of any kind*';
- balance between human and environment (eco-centric); '*resource use that aims to meet people's needs while preserving the environment*'.

We are currently examining the data to explore potential links between students' notions of sustainable development and the kinds of narrative evidence they felt were important when building arguments.

Discussions, future implications and opportunities

The majority of students were able to engage with and re-enact at least one science narrative in their argumentative positioning at this out-of-classroom venue, revealing science-related informal reasoning skills that had been at least in part developed in school (Kolstø, 2001). Narrative themes about buried radioactive waste and renewable energy sources were commonly selected by students as 'strong' evidence. Early analysis shows that students' persuasive dialogue within these narratives drew upon scientific and environmental evidence.

One challenge for students was evidently to 'take in' all they were experiencing in a relatively short two-hour time period (Figure 7). Students' abilities to weave observations and local narratives together with an analysis of the presented evidence were variable. In fact, very few students realised that the promise of building a 120 m high wind turbine on site had not materialised (although several noted that the turbine did not seem noisy or unsightly!). Perhaps this lack of attention to specific detail is unsurprising given that there was so much to see and discover. However, it raises important questions about supporting students' learning effectively outside the classroom so that *in situ* observation does make a true impact. The novelty effect of such experiences may also contribute to this, so learning orientation to an unfamiliar environment needs to happen swiftly. Most students' inability to see the bigger picture of everything apparently at their disposal serves as a timely reminder of the value of as much pre-visit orientation as possible.

Overall, the experience has provided valuable insights into creating science fieldwork opportunities in the built environment; the View Tube event has provided the material for the creation of a similar activity situated in a fictitious 'World Games' (Amos, 2012), now available with online support.

Figure 7 Examining the reused gas pipes on the Olympic stadium (View Tube behind)

Acknowledgements

Thanks to teachers and students from the following London schools who took part in the project: Bancrofts, Canon's High, Eastlea, Gladesmore, Graveney, Kingsbury High, Morpeth, Park High, Queen Elizabeth, Robert Clack, St Angela's, Sydenham and Virgo Fidelis. In addition, thanks to FSC tutors Jennifer Cooper and Catherine Gillatt for leading and developing the sessions.

References

Aikenhead, G. (2006) *Science Education for Everyday Life: Evidence-Based Practice*. New York: Teachers College Press.

Amos, R. (2012) Sustainable development – the World Games 2040. In *Performing Science: Teaching Chemistry, Physics and Biology Through Drama*, ed. Abrahams, I. and Braund, M. Ch. 5, pp. 76–78. London: Continuum. Companion website at: www.continuumbooks.com/CompanionWebsites/book-homepage.aspx?BookId=157937.

Amos, R. and Reiss, M. (2012) The benefits of residential fieldwork for school science: Insights from a five-year initiative for inner-city students in the UK. *International Journal of Science Education,* **34**(4), 485–511.

Association for Science Education Outdoor Science Working Group (2011) *Outdoor Science: a Co-ordinated Approach to High-Quality Teaching and Learning in Fieldwork for Science Education*. Field Studies Council and King's College London. Available at: www.ase.org.uk/documents/ases-oswg-report.

Bourn, D. and Brown, K. (2011) *Young People and International Development: Engagement and Learning*. Development Education Research Centre Research Paper No. 2. London: Development Education Research Centre. Available at: www.ioe.ac.uk/derc.

Department for Education (DfE) (2011) *National Curriculum for Science in England: Key Stage 3.* Available at: www.education.gov.uk/b00198831/science/ks3.

Department for Education and Skills (DfES) (2006) *Learning Outside the Classroom: Manifesto*. London: DfES. Available at: www.lotc.org.uk/about/manifesto.

Dillon, J. and Huang, J. (2010) Education for sustainable development: opportunity or threat? *School Science Review*, **92**(338), 39–44.

Fox, K. (2006) Authentic alternatives to practical work. *School Science Review*, **88**(322), 45–51.

Glackin, M. (2007) Using urban green space to teach science. *School Science Review*, **89**(327), 29–36.

Glackin, M. and Jones, B. (2012) Park and learn: improving opportunities for learning in local open spaces. *School Science Review*, **93**(344), 105–113.

Grace, M. (2010) Theme editorial: Education for sustainable development. *School Science Review*, **92**(338), 27–30.

Kolstø, S. (2001) Scientific literacy for citizenship: tools for dealing with the science dimension of controversial socioscientific issues. *Science Education*, **85**, 291–310.

Kuhn, D. (2001) How do people know? *Psychological Science*, **12**, 1–8.

Levinson, R. (2008) Promoting the role of the personal narrative in teaching controversial socio-scientific issues. *Science and Education,* **17**, 855–871.

Lock, R. (2010) Biological fieldwork in schools and colleges in the UK: an analysis of empirical research from 1963 to 2009. *Journal of Biological Education*, **44**(2), 58–64.

Sadler, T. and Fowler, S. (2006) A threshold model of content knowledge transfer for socioscientific argumentation. *Science Education*, **90**, 986–1004.

Simon, S., Erduran, S. and Osborne, J. (2006) Learning to teach argumentation: research and development in the science classroom. *International Journal of Science Education*, **28**(2–3), 235–260.

Stocklmayer, S., Rennie, L. and Gilbert, J. (2010) The roles of the formal and informal sectors in the provision of effective science education. *Studies in Science Education*, **46**(1), 1–44.

Websites

Development Education Research Centre, Institute of Education, University of London: www.ioe.ac.uk/derc.

The Economist: www.economist.com.

Field Studies Council: www.field-studies-council.org.

Games Monitor: www.gamesmonitor.org.uk.

Learning Outside the Classroom: www.lotc.org.uk.

London 2012 Olympic and Paralympic Games, Olympic Delivery Authority: www.london2012.com/sustainability.

The View Tube classroom and sustainable development activity can be booked with FSC London East until 2013: www.theviewtube.co.uk/learn.

Ruth Amos is a lecturer in science education and joint PGCE science course leader at the Institute of Education, University of London. Email: r.amos@ioe.ac.uk

Helen Robertson is the Head of Centre at Field Studies Council London East. Email: enquiries.le@field-studies-council.org