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Researching Science Learning Outside the Classroom

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Abstract: Although science continues to be a key subject in the education of the majority of young people throughout the world, it is becoming increasingly clear that school science is failing to win the hearts and minds of many of today's younger generation. Researchers have begun to look at ways in which the learning that takes place in museums, science centres and other informal settings can add value to science learning in schools. Four case studies are used to illustrate the potential afforded by informal contexts to research aspects of science learning. The case studies involve: the European Union PENCIL (Permanent European Resource Centre for Informal Learning) project (a network of 14 museums and science centres working with schools to enhance learning in maths and science); a large natural history museum in England; the Tate Modernart gallery in London, and the Outdoor Classroom Action Research Project which involved researchers working in school grounds, field centres and farms. The range of research questions that were asked are examined as are the methodological approaches taken and the methods used to collect and analyse data. Lessons learned from the studies about research in the informal contexts are discussed critically.

Key words: Science learning, informal contexts, research methods and methodologies, museums, science centres

Introduction

Few would argue that there are advantages to being scientifically illiterate and so science continues to be a key subject in the education of the majority of young people throughout the world. It is becoming increasingly clear, however, that school science is failing to win the hearts and minds of many of today's younger generation (see, for example, Schreiner and Sjøberg, 2007). As the data from the Relevance Of Science Education (ROSE) project indicates (see Fig. 1), school science does not appear to be particularly interesting in many countries especially those which are more economically developed.

However, as Fig. 2 indicates, the amount of time that we spend in school or other formal educational settings is a relatively small fraction of our waking lives. Researchers are beginning to play close attentionto discovering the true potential afforded by out-of-school contexts. For some years, policy makers and science educators have realised that out-of-school science appears to be more popular with young people than does in-school science. Researchers have begun to look at ways in which the learning that takes place in museums, science centres and other informal settings can add value to science learning in schools. It has to be said, of course, that the amount of waking time spent in museums and science centres is a minute fraction of the time spent in school. However, given the seeming popularity of such locations with the public and particularly young people, there may well be lessons to be learned about the way that science is presented that might help to improve science education in schools. It should also be noted that researchers are beginning to look at how young people might learn about science through the Internet and through electronic games.

This paper uses four case studies to illustrate the potential afforded by informal contexts to research aspects of science learning. The focus of the case studies is on their purpose and on the way in which research can be carried out in non-school settings rather than on the findings of the studies. The reason

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for this approach is to encourage researchers to consider what opportunities there are for carrying out research into science learning in informal settings and contexts.

The four case studies involve: the European Union PENCIL (Permanent European Resource Centre for Informal Learning) project (a network of 14 museums and science centres working with schools to enhance learning in maths and science); the London Natural History Museum; the Tate Modern art gallery in London; and the Outdoor Classroom Action Research Project which involved researchers working in school grounds, field centres and farms. All four projects were carried out by members of the Center for Informal Learning and Schools, a collaboration between King's College London, the University of California Santa Cruz and the San Francisco Exploratorium.

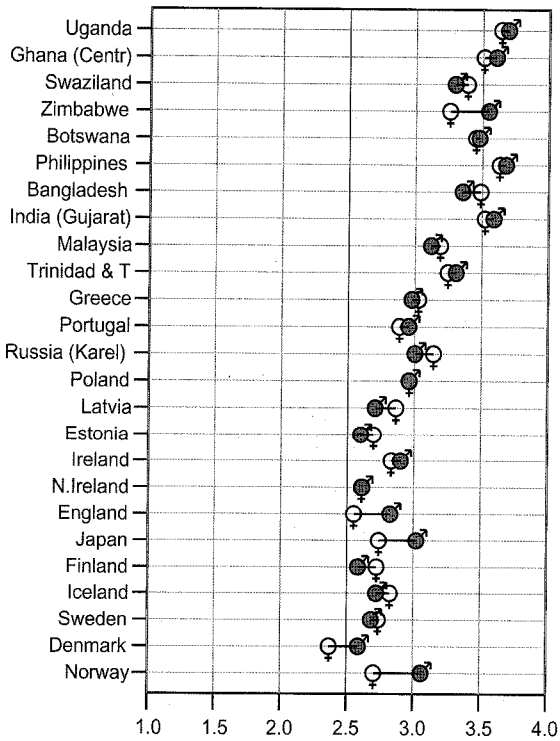

Fig. 1 Data from the ROSE survey. Students were asked to indicate to what extent they agreed with the statement 'School science is interesting'. Average scores for boys (filled symbols) and girls (open symbols). Positive scores are on the right of the graph, negative scores on the left. In countries that have a set of brackets next to the country name, data were sampled from a country region: Ghana has data from the Central region, India has data from Gujarat, and in Russia the data are collected from Karelia. 'Trinidad & T'denotes Trinidad and Tobago. Source: Schreiner and Sjøberg (2007, p. 259).

Research into science learning in informal contexts is a relatively new area. The majority of studies in museums and science centres have been carried out in the US, Australia and Canada. Many early studies could be placed under the heading 'visitor studies' (see http://www.visitorstudies.org/)and tended to be evaluations of visits to exhibitions or institutions rather than research into science learning. Until the advent of CILS, much of our own work tended to focus on schools, and that is true of the majority of science education researchers in Europe. A bibliographic database of relevant studies can be found at http://www.intute.ac.uk/healthandlifesciences/pscicom/pscicomlit.html

After a brief description of the background and purpose of CILS, the paper examines the range of research questions that were asked, the methodological approaches taken and the methods used to collect and analyse data. Lessons learned from the studies about research in the informal contexts are discussed critically.

The Center for Informal Learning and Schools

The Center for Informal Learning and Schools (CILS) is funded by the US National Science Foundation. It was founded in order to create a programme of research, scholarship and leadership in informal learning and the relationships between informal science institutions and schools. CILS is supported under the National Science Foundation's Centers for Learning and Teaching (CLT) programme, a comprehensive, research-based effort designed to address critical issues and national needs of the science, technology, engineering, and mathematics (STEM) instructional workforce across the entire spectrum of formal and informal education (see http://www.exploratorium.edu/CILS/about.html).

CILS addresses 'pressing problems confronting K-12 science education' by focusing on key components of the national science education infrastructure. In particular, CILS is concerned with making K-12 science education more compelling and accessible to a diverse student population, including students who

come from families with little formal experience of K-12 schools and science learning. CILS does this through studying science learning in out-of-school settings, including informal science institutions, and building programmatic bridges between out-of-school and school science learning. In tandem with these studies, CILS seeks to build on and strengthen modes and methods of engagement and conceptual development commonly found in those settings. CILS supports research and develops leadership in the study of informal science learning and institutions, and their relationships to schools.

CILS'mission is to strengthen science education through graduate, practitioner, and research programmes that broaden our understanding of learning in both formal and informal environments through the following activities:

- The generation of new academic and practitioner leadership through graduate and professional development programs.
- The generation of new knowledge and theory through research.
- The creation of mechanisms that effectively connect research and practice, so that the research is both useful to, and used by, the field (in the case defined as science education leaders and those who support them, in K-12 schools, districts, IHEs, and informal science institutions).

More details of CILS core activities can be found at the following web address: http://www.exploratorium.edu/CILS/.

Since its inception, CILS staff and students have been in volvedin a range of research studies some of which are described in the four case studies below. The case studies are designed to illustrate the range of projects that are taking place in the boundaries between formal and informal contexts.

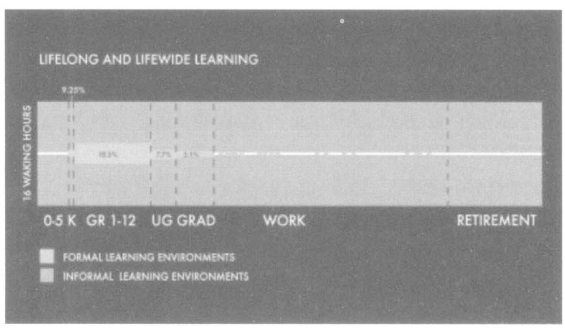

Fig. 2 Lifelong and lifewide learning. A schematic representation of the relative time spent during a person's waking life (assuming 8 hours sleep per night) in formal educational institutions. Source: http://life-slc.org/?page_id=124.

1. The PENCIL (Permanent European Resource Centre for Informal Learning) project

PENCIL is a network of 14 science centres and museums, two universities and several other institutions in twelve countries (mostly in Europe) that have committed themselves to carrying out innovative science and maths pilot projects aimed at school-age students. The aim of the pilot projects is to establish effective practice in working with schools and teachers. PENCIL is supported by the European Commission with a grant of 4.4 million euro. King's shares the evaluation of the projects with colleagues at the University of Naples and the Cittàdella Scienza, a science centre in Naples.

The original proposal for the PENCIL project envisaged the creation of two resource centres (RCs) with overlapping responsibilities. RC1 involved assisting the pilot projects by identifying research relevant to their work and monitoring their progress. RC2 involved the University of Naples setting up a Masters degree in science education and communication and, secondly, the Città della Scienza creating a physical archive of resources relevant to the informal learning field (see http://www.pencil.unina.it/encil.php).

At the outset of the project, PENCIL was designed, *inter alia,* to:

- Re-create a favourable environment for science teaching through re-motivation of teachers and renewed enthusiasm for learning by pupils
- Identify theoretical basics and best practices that bridge the gap between informal learning practices and formal teaching of science.
- Set up of pilot projects to experiment new techniques and or topics for renewing science teaching.
- Identify the criteria of innovation and quality that will have to guide successful teaching practices in the future.

PENCIL combined institution-based programmes

and academic research with the aim of identifying the keys to success that might transform informal science activities into innovative tools for science teaching. During the first two years of the project (from late 2004 to late 2006) the science centres and museums attempted to create mini-networks involving schools, pupils, teachers'associations, research laboratories, educational authorities and education and science communication specialists.

During all three years of the project (that is up to the end of 2007) an academic Resource Centre was developed that will provide a summary of educational research, science communication, learning in formal and informal contexts and effective practices. Xplora(see http://www.xplora.org/ww/en/pub/xplora/) a web-based science education portal was set up to facilitate communications between partners. ECSITE (the European Network of Science Centers and Museums) and EUN (European Schoolnet) will guarantee the sustainability of PENCIL after funding ceases in late 2007.

Research questions

The task of the King's and Naples teams was to devise an overall evaluation framework that met the needs of the project and its partners. Through a series of consultations, the final evaluation framework was agreed. The framework had two levels. Level 1 focused on the individual pilot projects. Level 2 focused on the overall working of the network.

The framework consisted of a series of overarching questions each of which was broken down in to a series of supplementary questions. So for example, the first overarching question focused on how the needs of stakeholders were taken in to account:

1. NEEDS –To what extent do stakeholder needs affect project design and implementation?

1a. Whose needs were taken into account in designing the project?
1b. How, and by whom, were these stakeholders identified?
1c. How were needs identified for each stakeholder?
1d. How did stakeholder needs affect the project design?
1e. How are stakeholder needs updated?

The full list of Level 1 questions is as follows:

1. NEEDS –To what extent do stakeholder needs affect project design and implementation?
2. RESEARCH/EXPERTISE – To what extent is the project taking account of existing good practice and experience?
3. SCIENTIFIC CONTENT – What is the science content and what model of science is portrayed?
4. DECISIONS/COLLABORATION – How do the project partners make and implement wise decisions?
5. EVALUATION – What is the project aiming to do and how does it monitor and evaluate its work?
6. EQUITY – To what extent does the project promote social justice and equity?
7. PEDAGOGY – What teaching approaches does the project choose and how does it identify effectiveness?
8. NETWORKING – How does the project receive and add value to the PENCIL network and to the wider education community?

The Level 2 evaluation questions were as follows:

1. ADDING VALUE –To what extent does the PENCIL network add value to the individual pilot projects?
2. CONNECTING WITH THE BROADER COMMUNITY – How and what does PENCIL communicate within ECSITE and beyond?
3. DECISION MAKING – How does PENCIL make decisions?
4. BARRIERS TO EFFECTIVENESS – What barriers to effectiveness are identified and how are they addressed?
5. MODELS AND THEORIES – What models and theories did the partners draw on?

Methodologies and methods

The overall methodological approach can best be described as both accretive/inductive (participant-observation & case studies) and transformatory (participatory action research). The research team had to both comment on what they saw and provide research evidence and suggestions for effective practice to each of the project partners. There is an inherent tension in this approach in that the research teams

had to both suggest actions and evaluate the effectiveness of their implementation.

In terms of methods, the pilot projects were widely distributed geographically, from Plymouth, UK to Athens, Greece and from Helsinki, Finland to Lisbon, Portugal. The 14 projects were divided between King's (6) and Naples (8). Once the evaluation framework had been agreed, the pilot projects were visited. Interviews (audio-taped) were carried out with key project personnel and field-notes were taken. Occasionally, researchers met with pilot project partners. A second visit, several months later, was designed to see what progress had been made with the pilot projects. In total, around ten researchers were involved in the evaluation visits.

2. The Darwin Centre: Researching Public Engagement

The London Natural History Museum's Darwin Centre provides world-class storage facilities for the museum's zoological spirit collections, modern laboratories and opportunities for the public to engage with scientists and their scientific work in person and through the museum's website. Darwin Phase One opened to the public on September 30th, 2002. In 2004, CILS was asked by the museum to examine how the Darwin Centre's public engagement offer related to the institution's newly drawn up learning strategy.

The Darwin Centre's public engagement offer, *Explore* and *Live,* had been in operation since the opening of Phase One. *Explore* provided escorted tours into the collections for small groups of the public. Live was a programme of sessions involving a 'host'talking with one of the museum staff or, occasionally, other invited speakers, in front of a public audience. Once a day (and occasionally more frequently), the sessions were webcast and some are archived on the museum's website (although at the time of writing there are no daily events as Phase 2 of the Darwin Centre is being built).

The museum commissioned CILS to carry out the review between December 2004 and February 2005. In reviewing learning opportunities in the Darwin Centre, we took the position that measuring long-term learning outcomes was beyond our remit. Rather, we made the assumption that, if appropriate teaching and engagement strategies were in operation, learning would generally take place.

The development of good practice in terms of public engagement is still young in the museum sector. Both *Explore* and *Live* originally set out to be experimental and visionary, and indeed they achieved that goal. Public access to the museum's collections and its scientists was unprecedented. The Darwin Centre faced a challenge typical of groundbreaking innovations –deciding how to move forward and subsequently exceed its original vision within its existing resources.

Research questions

The aim of the review was to assess to what extent the aims and practice of the *Live* and *Explore* services supported the strategic aims of the Learning Strategy. The review aimed to address the following issues:

- Definition of target audiences for Darwin Centre *Live* and *Explore*
- Planning and evaluating learning in the Darwin Centre
- Content of DC *Live* and *Explore* Sessions
- Frequency and length of DC Live and Explore sessions
- The role of dialogue in DC *Live* and *Explore*
- Integration of DC *Live* and *Explore*
- Training for Science and Learning staff
- The aims and provision for the training for Science and Learning staff

Methodologies and methods

The overall methodological approach can best be described as accretive/inductive (participant-observation & case studies). Some ethnographic methods were used though the overall methodology could not be described as an ethnography.

A mixed methods approach was used in carrying out the review. That is, complementary methods of data collection and analysis were employed by the research team. The team consisted of three researchers from CILS. The main sources of data and information on which the review were grounded were as follows:

- Analysis of existing evaluation/feedback;
- Interviews with key staff at the museum;
- Focus group discussions with staff from *Explore* and *Live*
- Individual interviews with *Explore* and *Live* staff after tours or events;
- Analysis of archived *Live* sessions;
- Participant observations of *Explore* and *Live* events;
- Interviews with visitors before, during and after visits;
- Email follow-up with *Explore* and *Live* participants after events;
- Examination of the Darwin Centre website;
- Multiple visits to the Darwin Centre;
- Video-taped observations of visitors in the exhibition area.

What Can the Matter Be?

In 2006, the UKs Engineering and Physical Sciences Research Council awarded Dr Mark Miodownik (Mechanical Engineering) and Justin Dillon (Education and Professional Studies) £82k to support their project 'What can the matter be?' The aim of the project is to investigate ways in which engagement with contemporary culture enhances the public's appreciation of science and engineering. The project has four strands:

1) *Guided Science Tours* of the Tate Modern which will cover three themes: chemistry/images, materials/form and engineering/installations.
2) *MP3 Science Tours of the* Tate Modern based on walking tours. They will be downloadable from the Tate Modern website prior to visiting the museum. The audio tours will be produced in partnership with the Education team at the Tate Modern.
3) *Materials Library Development:* Developing a new hands-on materials section of the Materials Library at King's, based on the pigments, materials, and technologies identified in the Tate Modern MP3 tour.
4) *Public Access to the Materials Library:* In particular offering days-out in London inwhich members of the public can take the MP3 tour of the Tate Modern in the morning and then visit the library in the afternoon and get hands-on experience of the sensual, aesthetic and physical properties of materials.

Programme of Work

The project hasthree phases: research, production and engagement (with a continuous evaluation). It commenced in September 2006 and will run for 12 months.

a) Research

Chemistry/Images (2D) The chemistry of the pigments in the paintings and photographs on display atthe Tate Modern will be explored as will the evolution of the ancient pigments through to the newer organic pigments that ushered in the Expressionist period. The science of brightness, hue and saturation, colour wheels and the origin of pure and complementary colours will be studied.

Materials/Form (3D) The wide range of materials used in sculpture at the Tate Modern and how the physics of each material affects the aesthetics, sensual properties and shaping possibilities will be introduced. The materiality of sculptures in Naum Gabo's Head No. 2, Alberto Giagometti's *Man Pointing,* Salvador Dali's *Lobster Telephone,* Rodin's *The Kiss* and Richard Deacon's *Struck Dumb* will be considered.

How the science of new materials is reflected in the collection will beexamined. This will include how new technologies are changing what is possible. For instance questions such as whether the introduction of rapid prototyping will do to sculpture in the 21st century what photography did to painting in the 20th century will be explored.

Engineering/Installations (4D) The engineering of installations will be considered, such as that for Cornelia Parker's *Cold Dark Matter;* Exploded Shed and other complex installations in the Tate Modern.

b) Production

The MP3 will be produced in close association with the Tate Modern, which hasexperience in this area. The last tracks on the MP3 will relate to the Materials Library Tate Modern exhibit at King's and provide information for the public about how to arrange a visit.

c) Engagement (Communication strategy)

The key to our strategy is to increase the public's sense of wonder at the Tate Modern and to appeal to

their curiosity by unveiling the interplay between science and art. It should feel like they being let in on a secret, rather than about facts. We want try out this type of approach by conducting two walking tours of the exhibition for each theme. Self-guided MP3 tours are becoming increasingly common in museums and galleries. We feel that this medium will be not only convenient but also embed our main message that technology and science is important to all cultural change.

Research questions

The extent to which science and technology is communicated in an enjoyable and interesting manner through the MP3 tours will be examined. The study will focus on whether the science deepens people's experience of art and whether it makes them more interested in finding out more about the science.

Methodologies and methods

In terms of methodologies, we will be taking part as participant-observers as well as carrying out case studies. Ethnographic methods will be used although the study cannot be described as an ethnography. Having said that, the study could be described as an ethnomethodology –in that at times the researcher seeks to break codes and mores without offending in order to understand processes of social control and boundaries (Garfinkel, 1967). An alternative approach might be to use phenomenology in which the researcher develops descriptions in which all expectations are radically suspended (Schutz, 1976).

The evaluation will involve conducting short interviews during and after the tours. A cross-selection of visitors (age, gender, ethnic background) will be asked if they would give their anonymous impressions of what they were expecting to experience before the tours and then asked again after the tours what they found interesting, and what they found difficult to understand. This aspect of the research commenced in 2007.

We estimate that if only 5% of the annual visitors see the MP3 link on the Tate Modern web site, and if only 10% of those engage with the project, we will still reach 20,000 people. We will be monitoring the recorded number of downloads of the MP3 both from the Tate Modern website and the project website.

4. The Outdoor Classroom Action Research Project

There is growing concern about declining opportunities for outdoor learning and low levels of understanding about food, farming and sustainability issues amongst young people in this country. The recent UK Education and Skills Select Committee Enquiry (2005) into *Education Outside the Classroom* as well as OFSTED's (2004) report on *Outdoor Education* are reflections of this trend. Furthermore, the Government's Growing Schools Programme seeks to enable *'schools to make better use of the outdoor classroom as a context for teaching and learning'* (DfES, 2005). Two research publications – an NFER/King's review of research on food and farming education (Dillon *et al.,* 2003), and a CEE/Bath evaluation of the Growing Schools Innovation Fund Projects (Scott *et al.,* 2004) - both highlighted the need for stronger empirical and conceptual understandings of learning in the outdoor classroom. This project sought to meet this need.

The research was carried out by a team from the National Foundation for Educational Research (NFER), King's College London and the University of Bath. The aim was to extend research-based understandings of educational activities using the outdoor classroom in a rural context. More specifically, it focused on the processes and impacts and the planning and evaluation of outdoor learning. These issues were explored in three outdoor learning contexts: (i) school grounds and gardens; (ii) farms and city farms; and (iii) field study/nature centres.

The study involved identifying case studies of effective practice, observing students and teachers at work in school grounds, on farms and in outdoor study centres across England. Part of the study involved action research with outdoor educators, and focus groups and seminars with leading proponents in their field. The work was undertaken during 2004 and the early part of 2005, and was funded by the Department for Education and Skills, the Countryside Agency, and Farming and Countryside in Education (FACE).

Research questions

The aim of the project was to extend our understanding of educational activities that use the outdoor classroom in the rural context. In particular, we were

interested in the conceptualisation (visioning), planning, practice, impacts and evaluation of outdoor learning. More specifically, the project sought to explore:

- the academic, social and personal benefits for students
- the barriers to students'learning and strategies for overcoming these
- the effectiveness of different kinds of resources and activities
- how to deliver outdoor experiences economically and effectively
- how to evaluate and research outdoor learning
- how to integrate outdoor learning into the school curriculum.

A series of challenges exist with all research of this kind, particularly the extent to which it is possible to know what learning accrues from particular educational activities, given all the other influences that exist. A compounding factor with this research was its short timescale, and the limits that this placed on with whom we could work and the extent of this work. All these factors limited the data available to us, and so our research strategy was to identify the benefits, barriers and effective strategies within three specific contexts, and to draw on the views of teachers, learners and managers in each of these.

Methodologies and methods

In order to produce a range of evidence, the research strategy used a multi-strand approach (see Fig. 3, below), which involved three parallel approaches:

Strand 1: Case-Study Research- comprising in-depth qualitative investigations into the processes and impacts of outdoor learning activities at six outdoor learning sites.

Strand 2: Action Research- involving a small group of outdoor educators carrying out small-scale research in their own work settings.

Strand 3: Stakeholder Consultation- involving focus groups and seminars with a range of stakeholders involved in outdoor education.

Each of the three strands examined three outdoor learning contexts, all of which can be used for specific, wider-curriculum and extra-curricular work:

School contexts: for example, school grounds, school gardens and school farms

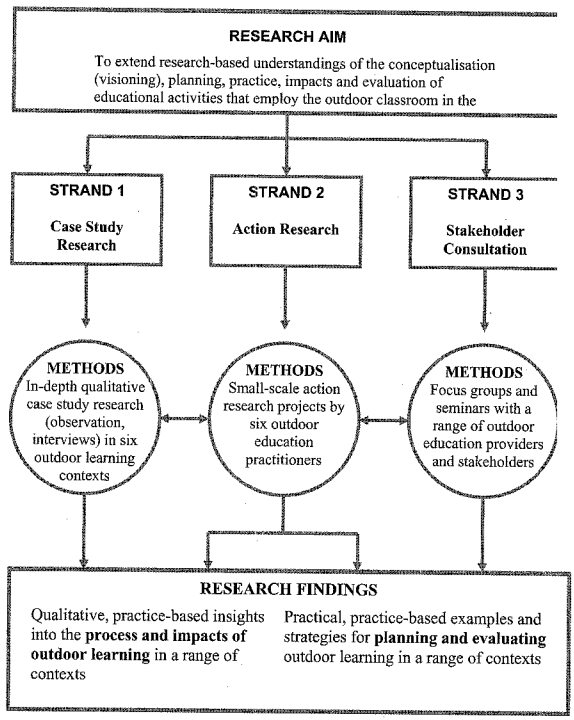

Fig. 3 The overall research design of the Outdoor Classroom project. Source: Dillon et al. (2005).

Farm contexts: for example, farms and city farms

Outdoor centre contexts: for example, field study centres, nature centres and country parks.

Discussion

The four research projects differ in terms of size, scale, funding, geographical distribution and so on. Together, they indicate the opportunities afforded by the growing interest in the learning that takes place in so-called informal contexts. In some cases, such as the Darwin Centre or the PENCIL project, the divide between what counts as research and what counts as evaluation is blurred. In the case of the Outdoor Classroom project, the divide between formal and informal contexts is equally blurred. What is becoming clearer is that existing terms and approaches are more contested now than they were some years ago.

The work of the Center for Informal Learning and Schools crosses the boundary, if it exists, between formal and informal contexts. Using terms such as informal learning and formal learning appears increasingly unsustainable. The notion of 'free-choice learning' (Falk *et al.* 1999) seems equally problematic.

In the UK, the government has recently launched the Learning Outside the Classroom Manifesto (DfES, 2006). The Manifesto is, according to the DfES (*ibid.*), 'a shared statement of intent for all who see the benefits to young people and want to help bring about this vision of high quality, meaningful learning experiences for all.' The Manifesto is based on the assumption that 'every young person should experience the world beyond the classroom as an essential part of learning and personal development, whatever their age, ability or circumstances' and the realisation that, at the moment, many do not. The emphasis in this initiative is about adding value to the learning that takes place in the classroom through activities which might be voluntary or not and which be school-focused or not. The distinction between formal and informal is becoming increasingly unnecessary in discussing lifelong learning. However, the distinction between classroom and out-of-the classroom experiences is, in its own way, problematic.

In the following sections, each of the four projects described above, is discussed in terms of lessons learned that might be of use to researchers.

Lessons from the PENCIL project

One lesson that we learned from our involvement in the PENCIL project is that it is difficult to support the pilot projects and, simultaneously, evaluate their success. We consciously decided to adopt a formative approach, in that we used the evaluation framework as a means to encourage the pilot projects to reflect on their work. The fact that the pilot projects were spread across Europe and were working in their native languages made it impossible for us to offer valid evaluations of many aspects of their work. What we could do was to provide evidence from research of good practice in the museum and science centre worlds and act as critical friends, questioning and supporting project team members. We were also able to support the pilot projects as they embarked on their own internal evaluations of their effectiveness.

Lessons from the Darwin Centre project

The Darwin Centre provided interesting challenges. How, for example, can you find out what 50 or more participants in a public engagement event thought of the experience quickly and reliably? How can you describe effective practice in guiding a tour of a museum's resources. The Natural History Museum, like all large institutions, is not a homogeneous group of people. Wewere privileged to be allowed access to staff and resources because we were commissioned to carry out the evaluation for the museum. We have not, as yet, been able to publish as much as we would have liked to have done partly because of time pressures andpartly because of the need to maintain anonymity of museum staff. Probably the main lesson that emerged from the study, from the research perspective, is the need to provide findings which are both accurate and which respect the museum's culture and its staff.

Lessons from What Can the Matter Be?

Early in the project, an opportunity arose to evaluate four evening sessions at the Tate Modern which focused on the art/science/technology overlap. For about 90 minutes, each Monday evening, a group of about 75 or more people independently toured one of the galleries. In many of the rooms a table had been set up and an explainer ('Conjecturer') helped the public to engage with both the art and a hands-on exhibit. Our job was to evaluate the four sessions withoutbeing intrusive or without influencing what was happening. This was a challenging task and one which relied on participant observation as well as a disciplined approach to time-management. One lesson we learned was that having several researchers trained in museum and science centre education activities was invaluable in making sense of what was happening in a unique environment. As with all the projects mentioned in this paper, the advantages of working as part of a team vastly outweigh any disadvantages.

Lessons from the Outdoor Classroom Action Research Project

This project involved working with two other institutions across a range of sites using varied approaches. The time constraints and the infrequency of project meetings contrasted with some of the other projects described. Funders often want research carried out within seemingly impossible timetables and this project was no exception. Dividing the work between

the institutions by strand made sense but it was hard to get an overview of how the project was moving on.

Conclusion

There is no doubt that science education is undergoing a change in its focus as researchers continue to move beyond the classroom. Institutions and organisations that provide learning outside the classroom, and their funders or customers, want to know what impact the experiences are having on students. A range of research opportunities are emerging that are providing interesting and challenging opportunities for new work. Journals and research associations are increasing the amount of time and space devoted to non-school learning. However, the same levels of rigour need to be applied to research outside the classroom as have been used researching in the classroom.

The international dimension of research into learning outside the classroom is also developing with countries such as South Korea considering new museums and science centres for this new century. Research institutions and funding bodies worldwide are beginning to respond to the new challenges and opportunities afforded by the growing interest in learning beyond the classroom.

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