13 A GUIDE FOR SUCCESSFULLY EVALUATING SCIENCE ENGAGEMENT EVENTS

With science communication and public engagement a burgeoning field, it is important to ask what effect it is having. Evaluation is crucial, agree **Ben Gammon** and **Alex Burch**, but difficult. Most interesting – but hardest to identify – is deep, lasting impact. As well as the methodological challenge, disentangling the impact of other factors would be extremely difficult. Better to focus on clear short-term objectives, and to collect the right data to assess how well these objectives have been met.

Evaluation is usually part of the plan for science engagement, and funders often require it. But it is hard to do well. Getting evaluation right demands as much careful thinking as designing an event or activity in the first place, and the two really go together. There is a secret to successful evaluation: clarity – about project aims, target audience, the aims of the evaluation and how the data will be used. If you can achieve this, you are a long way towards successfully evaluating your science engagement programme.

When to evaluate

Evaluation should be conducted throughout a project: during planning (front-end), development (formative) and on completion (summative). Front-end evaluation aims to identify the needs, wants and prior knowledge of the target audience. What topics will capture the audience's interest? What topics that you must cover will be challenging or initially uninteresting for the audience? What do they already know that you do not need to cover? What format of event works best for this topic and this audience? Ideally you will use focus groups or in-depth interviews, but there is also a lot of valuable information freely available in science communication and science education research, evaluation reports from earlier projects, and market research conducted by companies such as MORI.

Formative evaluation aims to identify faults in the design and delivery of events, for example by running trial events in front of test audiences prior to the launch of the full-scale project. Formative evaluation should be an iterative process quickly identifying problems, making modifications and retesting the event.

Summative evaluation aims to assess whether the project met its objectives. Ideally the summative evaluation from one project becomes the front-end evaluation for the next. Summative evaluation of science engagement events presents a number of particular challenges, especially whether to assess the immediate or the long-term impact. There is often pressure to evaluate the long-term impact yet there are severe practical problems to overcome. How will you maintain contact with a reliable sample of participants to conduct this research? How will you ensure that you are not altering participants' opinions and behaviour by maintaining this contact? Do you have the resources to conduct long-term studies lasting months or even years? How will you ensure that what you are measuring is truly the impact of your event and not of a multitude of different experiences that a participant may have had in the meantime?

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More fundamentally, we need to decide how long is 'long-term', and what counts as long-term impact. One approach that has been used is Prochaska's model.[1] This model, originally used in studies of public health education, proposes that different people are at different points of readiness to change their behaviour:

1. **pre-contemplation** – not interested in changing behaviour
2. **contemplation** – thinking about changing behaviour over some time period
3. **preparation** – committed to changing behaviour and making plans to change
4. **action** – has changed behaviour and taken action
5. **maintenance** – evidence of long-term change in behaviour.

So one way to assess the long-term impact of science engagement is to explore whether participants' positions along this continuum have shifted. However, this is far from straightforward. Learning is personal and dependent upon the context in which it happens. The outcomes of any science engagement activity will vary dramatically between individuals. It is therefore likely that an extremely complex pattern of long-term outcomes will be generated by any event. Furthermore, there is evidence that outcomes change over time and therefore different results may be attained depending on when you choose to conduct the follow-up evaluation. Falk *et al*. found that immediately after a visit to a science museum, visitors showed outcomes predominantly centred on increased knowledge and

EDUCATIONAL EDEN

Cornwall's Eden Project combines magnificent countryside, architecture, science and the arts, creating an inspiring environment for informal learning.

Opened in 2000, the Eden Project has rapidly become one of the UK's favourite destinations. Two vast greenhouses, or Biomes, are housed in the large crater on which the site is based. Occupying more than two hectares, these vast honeycomb structures house plants, crops and landscapes from the tropics and warmer temperate regions. Outside, in the Outdoor Biome, are a further 15 hectares of beautiful temperate landscape.

But the Eden Project is about far more than beauty. Behind the exhibitions, stories, art, events, lectures or →

EDEN PROJECT

Funding
£734 000 (2004, Rediscover award; £175 000 from the Wellcome Trust) – The Mechanical Theatre of Issues

£40 000 (2003, Pulse award) – Signs of Life

Project leads
Dr Tony Kendle and Will Jackson (Mechanical Theatre of Issues)

Emma Mansfield (Signs of Life)

More details
www.edenproject.com
www.engineeredarts.co.uk

Left: 'Biomes' at the Eden Project in Cornwall. *SPL*

skills.[2] However, after four to eight months, the researchers found far fewer reports of increased knowledge and skills and instead more outcomes based around the awareness of issues and the social aspects of the visit. Similarly, studies of visitors to 'Conservation Station', in Disney's Animal Kingdom, found that the impact of the experience varied according to visitors' prior knowledge and attitudes.[3] In particular, the impact upon visitors' conservation behaviour varied significantly according to how committed they already were to conservation, and across all categories of visitor, impact faded over just two to three months.

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Summative evaluation of long-term impact is certainly not impossible but it requires considerable resources, planning and time, and the data are difficult to interpret. If time and resources are limited it is advisable to focus instead on reliable data about immediate impact rather than poor-quality and potentially misleading data about long-term impact.

What is science engagement trying to achieve?

Science engagement covers a vast array of different initiatives. So once you have decided when to evaluate, the first step is to clarify what a particular project is trying to achieve. Different activities aim to achieve very different goals, yet these differences are often not acknowledged. This leads to choice of inappropriate indicators of success.

The Science Museum's Dana Centre team developed an evaluation of its innovative programme of science engagement events using a 'wedding cake' structure for categorising events. The base of the cake constitutes the largest proportion of science engagement events. These aim broadly to generate public interest in science. For example, these events may include panel discussions, stand-up comedy, drama, poetry, etc., but all feature largely one-way information flow.

The second layer of the cake represents a smaller proportion of science engagement activities. These are 'dialogue events', which aim to generate open-ended discussion between the general public, scientists, policy makers and campaigners. Such events often have the following objectives: to build trust, understanding and empathy between the public, scientists and policy makers; and to provide an opportunity for thoughtful and informed debate. While such events may be traditional debates, the Dana Centre successfully used a wide range of innovative formats including forum theatre, gameshows and small group discussions.

The final layer represents the smallest proportion of science engagement activities, where the public are engaged in a sustained dialogue to guide the development of government policy. These events typically involve very small numbers of people over an extended period. A recent example of such a project was Meeting of Minds, which involved panels of 12 citizens from nine EU countries and was conducted over the course of 18 months.[4]

While the events in each layer differ in their aims, they are related in the broad intent to increase public interest and participation in science. The important point for evaluation is to be clear about which layer an event belongs to. There is little point in trying to assess an event's impact upon government policy if this was never the intention.

Defining success, defining failure

The next step is to define indicators of success and, equally importantly, of failure. This second set of indicators is crucial if evaluation is to lead to better practice.

Evaluation results from many different science engagement projects show how the needs and wants of participants can be arranged into a hierarchy. Certain basic needs have to be fulfilled, regardless of the aims, audience or format of the event. For example, participants have to be physically comfortable, able to see and hear the presenters and free from distractions. Only when these have been met do more subtle needs and wants become apparent. For example, participants need to feel some sense of identity with at least a portion of the audience; they need to feel that their opinions will be valued and respected even if not agreed with. Furthermore, we found that even when such physical and social needs are met there are other powerful needs that have to be fulfilled: most notably, participants in science engagement events are 'hungry' for information and for new and challenging ideas. People do not – unsurprisingly – want to be told what they already know. They wish to make the most of coming into contact with scientists and expert science communicators. We found that for genuine discussion to occur in dialogue events the audience must first feel confident about the basic issues and terminology in order to express their opinions. Nobody wants to ask a stupid question in front of experts and an audience.

We interpreted these findings using a modified version of psychologist Abraham Maslow's classic hierarchy of personal needs.[5] Participants have needs at a number of levels:

- **Physical needs** – the physical comfort of the presenters/performers/speakers and audience.

→ workshops is an important educational message: if we want to keep celebrating nature, we need to understand how to work with it – we are a part of nature. Rather than using apocalyptic scenarios to hammer this message home, however, the Eden Project nurtures its visitors, much like its plants, gently reconnecting people with their planet.

Everything about the Eden Project is welcoming. Every plant has a story to tell, and Eden wants you to hear it. Its playground environment, making terrific use of interactive games, striking automata and sculptures, hooks younger visitors and brings out the child in their accompanying parents. Suddenly their world is truly alive and visitors want to understand how plants grow, where soil comes from or how to adopt a more sustainable approach to life.

Throwing itself wholeheartedly into novel routes to science communication, Eden is constantly exploring new means to engage. It has developed collaborations between scientists, artists, teachers and marketing specialists to great effect.

With Rediscover funding, for example, it has collaborated with Will Jackson and colleagues at Engineered Arts to develop an interactive gallery along the lines of an amusement arcade or fairground. Sophisticated mechanical models will provide an immersive experience, in which visitors will be able to explore deep issues about the nature of science and how it relates to people. →

Right: The Mechanical Theatre of Issues. *Engineered Arts*

- **Social acceptance** – audience and speakers/performers feel emotionally comfortable.
- **Intellectual** – participants feel that they have learned something, that they understand enough about the topic to contribute to the discussion.
- **Self-actualisation** – event achieves full potential. Participants feel they have taken part in something worthwhile and leave with a sense of accomplishment; the impact of the experience lasts over time.

When planning a science engagement event it is important to define the particular higher-level needs and to devise indicators that these are, or are not, being met. For example, for Dana Centre events, dialogue was defined as "the exchange of ideas, opinions, beliefs, and feelings about the topic of the event between speakers and the audience. It is listening with respect to others and being able to express one's own views with confidence." Based on this definition, indicators of success included:

- questions moving quickly from requests for factual information towards the rhetorical or statements of belief, e.g. "if you really believe x then why do you...?"
- contributors reflecting the language of previous speakers/questioners in what they say, i.e. actively listening and referring to previous points or questions.

How to conduct the evaluation

Only when the aims of the event have been clearly defined should methodology be considered. Aims should define methods, not the other way round. The choice of method should be based upon a clear understanding of the strengths and weaknesses of different techniques and of the practical difficulties of applying them to live events.

For evaluation to be successful, the organisation must want to do it, rather than doing it because they are required to by a sponsor.

Interviews with participants will provide in-depth information about their reactions to the event but it is unlikely you will be able to capture a large enough sample to yield quantitative data. Self-completion questionnaires may provide a much larger sample but these are often highly unrepresentative, missing people who do not or cannot fill in the forms. Furthermore, self-completion questionnaires lack depth of response.

An interesting hybrid approach is an email questionnaire. This provides the opportunity for both in-depth questioning and a more representative sampling of the audience. Email questionnaires yield considerable depth of response, typically achieve response rates of 40–80 per cent, and have the added advantage that follow-up interviews can easily be conducted at a later date.

Focus groups are good for obtaining very detailed responses from participants. A skilful moderator can explore participants' opinions in great depth. However, focus groups are expensive, time-consuming and require considerable training and experience to run effectively.

One of the most powerful yet least used techniques for evaluating live events is observation. Through the careful observation of the audience it is possible to gauge how successfully the event is being run.

No one evaluation technique is likely to deliver all the aims of the research. We recommended a mixture of methods.

Conclusions

The first secret to successfully evaluation is clarity. The second is commitment of the organisation to the importance of evaluation. It is entirely possible to follow good practice in evaluation with clarity of aims, outcomes and methodology but for it to have little or no impact. For evaluation to be successful, the organisation must want to do it, rather than doing it because they are required to by a sponsor. Evaluation should be done primarily to improve practice, not merely to 'prove' success. Evaluation needs to be the responsibility of a senior member of staff who will advocate its importance on all project teams. Ultimately evaluation needs to directly influence planning of future projects and training of staff. If you can achieve that, you will have successful evaluation.

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References

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2 Falk JH et al. Interactives and visitor learning. Curator 2004;47(2):171–99.

3 Dierking LD et al. Using a behavior change model to document the impact of visits to Disney's Animal Kingdom: a study investigating intended conservation action. Curator 2004;47(3):322–34.

4 www.meetingmindseurope.org.

5 Maslow AH. Towards a Psychology of Being. Princeton NJ: Van Nostrand; 1962.

Further reading

Anderson D. Visitors' long-term memories of world expositions. Curator 2003;46(4):401–20.

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→ And in its Pulse project, Eden teamed up with students from Truro College and experienced theatre artists and writers to develop a drama work based on genetic engineering of foodstuffs.

Overall, the Eden Project exemplifies a key aspect of informal learning: the experience has to engage with people at an emotional level. With this connection made, visitors are motivated to find out more. By focusing on their needs and desires, the project can then lead them on a journey of exploration and discovery.

Right: Immersive techniques can aid engagement. *Engineered Arts*

Rediscover funding

The Rediscover initiative was a £33 million joint venture between the Millennium Commission, the Wellcome Trust and the Wolfson Foundation. It offered grants to science/discovery centres and museums to renew and redevelop their science and technology exhibitions.

Pulse awards

Part of the Engaging Science funding programme, Pulse awards provide funding for projects aimed at those 22 years and younger and encourage the use of any art form (or combination of art forms) to engage young people in the historical, social, ethical, cultural or contemporary issues arising from biomedical science.

www.wellcome.ac.uk/pulse