Interactive design and construction – an overview

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These brief notes give a general overview on the principles behind the design and construction of interactive exhibits. There are many more issues to consider in all of the topic areas described below than we can discuss here: this is an introduction to a complex subject.

Introduction to Interactives

Many research students and staff approach the design of an interactive exhibit with a view to its use in a particular presentation or workshop. It's useful, however, to consider a broader possible range of uses for such an interactive, before you embark on its design: a properly designed interactive can have a greatly extended lifetime and scope.

We will discuss the construction of interactive demonstrations under the set of headings listed below, each of which will be expanded upon later. Interactives that have been designed (by members of a department or school) with these considerations in mind can later be used by others in a variety of environments, including UCAS visits, science festivals, schools outreach and CPD sessions.

Fundamental Principles

The following list of topics is intended to give you some of the overarching principles behind interactive design, in its broadest possible context. While some of these principles might be ones that you will eventually put aside for the design or construction, they are certainly ones that you should consider before you begin. A basic truism is that it's more difficult to retroactively design an interactive for a different use than its original intent, than it would have been to design it with that possibility in the first place.

All of the topics discussed below are obvious (with hindsight), but it's instructive to consider just how many of them are forgotten about during the design stage.

Our principles for interactive development can be considered under the following headings, each of which is discussed in more detail:

- Basic type
- Mobility
- Modularity
- Staffing
- Target audience
- Target venue
- Type of interaction
- Supporting materials

1) Basic Type

- *A single, stand-alone exhibit, with few (or limited) conceptual links to other interactives.*

  This is most often true when you're building a demonstrator for a highly specialised piece of research: outreach exhibits are often, however, illustrating fundamental principles.

- *Part of an exhibit cluster.*

  Sometimes you will be building an interactive that is intended to be part of a group of exhibits, connected by an overarching theme, which might be as simple as the graphic design of the set, as part of an exhibition or display, but in more complex cases may involve a coordinated approach to the content of all of the exhibits. An example of the latter case would be the Particle Physics for Scottish Schools project, $p\,\bar{p}\,4\,\bar{s}\,s$ (*www.scifun.ed.ac.uk/pp4ss*), for which we designed a series of eight exhibits, as part of two story arcs: the first being an introduction to particle accelerators, taking students through the various physical principles of operation; and the second being a more general overview of particle detectors, with emphasis on the detection of cosmic rays. These exhibits were from the outset designed as a complete group.

2) Mobility

- *Fixed venue*

  When an interactive is to be permanently sited in a venue, some design problems are minimised: access to power and a network are often straightforward, and many of the issues in the modularity section can be sidestepped.

- *Portable*

  Most interactives will be used in this way, in a variety of venues. In the extreme case (when used as part of an outreach group like SCI-FUN, for example), the exhibit must be designed to be taken to many locations with widely differing requirements (discussed later).
  At minimum you have to consider the way in which the interactive will be connected to the local environment. Not all venues will have immediate power, networking, water or other consumables, for example. (See later for more.)
  When many such exhibits are to be built (and this may apply to a collection of interactives from a variety of designers), modularity is increasingly important, described next.

3) Modularity

When you are building interactives that you know will be used alongside others, or which will be demonstrated on many occasions, the issues raised under this section are extremely important. Even if you (personally) never intend to use the interactive again, or to have it included with others, designing your exhibit to be modular will help to increase both its utility and longevity.

- *Set-up and disassembly time*

  This is easy to overlook when you're building something that you alone will use: you'll be familiar with the interactive, and with all its quirks of assembly and disassembly. It's also likely that a particularly long set-up time, or one which is overly fiddly, won't cause too many problems. If we now imagine that the interactive is to be used by many others, and that it may be part of a larger group of exhibits, such that set-up time becomes a problem, we see that the proper design of an interactive to be easy to set up or take apart, which has instructions for assembly or operation (for the uninitiated), and with proper storage of components (see below), will make the interactive a lot more likely to be used in future.

- *Robustness*

  This of course depends on your target audience, and on the intrinsic fragility or safety of the interactive. There are some which, by their nature, just cannot be used (or even touched) by anyone other than the demonstrator. There's a whole set of things you have to consider (that can't be covered in this short document) if you want to design an interactive that's to be used by the public. Some issues are ergonomic, while others are pedagogical, but over all of these is the simple principle of making something that will withstand considerable punishment (12-year old children being possibly the most destructive force in nature). For most interactives, a robust design will mean that the end result will last a lot longer (and, just as importantly, continue to look good), especially if it is intended to be highly portable.

- *Components / consumable storage*

  Many interactives will have a number of component parts. Where possible these should be designed to be part of the overall exhibit, especially if it's one that's to be moved to a variety of venues. Again, if your focus is simply "next week's talk", and the horizon extends no further than that, you can get away with loose cables, instruments, bags of components, visual aids, and the like. An exhibit such as that, however, is likely to have limited use one year on (when you've left, say), and no-one can find (or even know about the need for) the bags of bits and pieces that should have been designed to fit into a properly boxed and inventoried interactive.

- *Transportation issues*

  This is another topic whose importance is predicated on the number of times the interactive will be used, and also the number of accompanying interactives. *In extremis*, a group such as SCI-FUN depends entirely on the efficient transportation and storage of up to fifty different exhibits, and the correct initial design of such exhibits is critical to the operation of the group. For more limited use, however, it is still true that a well-packaged interactive will be much more likely to be used than one which has not been designed for easy transport. (A good example of this is the $p\bar{p}4\bar{s}s$ LHC accelerator simulator (shown below), which was originally a PC, monitor and front-end box, with a variety of supplementary components. It was only after the entire unit was properly modularised, including being enclosed in a box with handles, that it was extensively used by a variety of Physics presenters.)

An example of a modular exhibit: the PP4SS LHC simulator. Everything needed to run the unit is stored in the carrying case, which is an integral part of the base assembly.

4) Staffing

This is another "future" issue, if your interactive is to be used by others. We consider the basic partition of interactives into two broad types.

- *Unchaperoned*

  Interactives such as this are intended to be used without any permanent staff (in fixed venues, for example), or at larger venues (such as the Science Festival), where there may not be sufficient volunteers for continuous cover. The early recognition that your interactive *may* be used in this way (even if at first you may simply use it in another environment, such as a hosted workshop) will constrain many of your design and exhibit-dressing choices, including basic construction, user safety, ruggedness, and the need for additional (or more detailed) information on the use (and point) of the exhibit.

- *Chaperoned*

  Such exhibits (which may include an interactive designed for a public outreach lecture) may require staffing for a variety of reasons: it's potentially dangerous if used by the unskilled; it's highly fragile or costly; or, it's too conceptually complex to be used properly without a narrator or demonstrator. These issues impinge less upon the actual design of the interactive than they do on its utility for future use: it tends to constrain the possible venues at which the interactive may be deployed. Scripts are required for such an exhibit, for untrained staff: design these in from the very beginning.

5) Target audience

It's important at the very start to know the audience for whom your interactive is intended. University researchers are notoriously poor at this: often (and for a variety of reasons) they pitch their material in an inappropriate fashion, or with the wrong presentational style.

This is only the briefest of discussions of the issue: there's a huge amount to consider here, when it comes to interactive design.

- *Specific age range*

  It's likely (though not always) that you'll want to limit your presentation to a particular age-range: primary, lower secondary, upper secondary and adult being a standard breakdown. This decision will affect the content of the interactive, of course, and will also impose limitations on its future use. In some cases (and we have done this with some SCI-FUN exhibits) you can design the interactive content and graphics such that – depending on the venue and age-range expected – the interactive can be dressed (and used) in different ways. Again, this is something that has to be considered at an early stage of design. Certain pedagogical decisions can be made here with regard to the way in which you present your interactive. It's common, for example (though we don't necessarily recommend this), for interactives aimed at young audiences to tend towards a cartoon-like approach. While this may be necessary for the youngest audiences, it will preclude the use of the interactive with groups who may find such a presentational style off-putting. (See also the final comment below.)

- *Narrow / wide range*

  Most interactives are (with the exception of the multi-tasked exhibit above) designed for a fairly narrow range of ages: it's often considered to be too hard to prepare an exhibit (and especially the content) for a wide range of levels of understanding.

- *Level of understanding*

  This is really the same as the previous two topics, in that you may have to consider the use of your interactive for an audience whose interest and understanding vary widely (even if their ages do not). In such cases, the basic presentational mechanisms may differ primarily in level of content, rather than in the pedagogical approach. For example, an adult audience might be broken into three categories: non-scientific; the interested

layman or non-specialist; and someone with a greater (but narrower) focus. (In general, university researchers are most comfortable with the last of these categories.)

There's an overarching criterion that we apply to all shows and exhibit materials produced by SCI-FUN: an adult who walks into the room where a presentation is taking place – or who comes across the exhibits that are being used by pupils – shouldn't feel that he or she is out-of-place, or attending a children's event: we can teach science by *simplifying*, rather than dumbing down, and our material should be of interest to everyone.

6) Target venue

- *Environmental requirements*

  These are issues that will constrain the use of your interactive, and many venues will impose formal requirements on its deployment. Such issues include: power; water; consumable availability; specific lighting / sound (silence, noise) requirements; chemical safety; fire and smoke production. At the very least you need to properly document important interactive issues in accompanying materials.

- *Additional requirements*

  Again (and for future use by others) you should document all special requirements of the interactive, including projection requirements (data projectors, screens, video cameras), specialist sound, and so on.

- *Risk assessment*

  Your interactive may be taken to a public venue with strict safety guidelines. A proper risk assessment analysis at the start of your design is easy to do, and can prevent embarrassing problems later (such as exhibits being turned away from presentations, just before they're due to be used). SCI-FUN has years of experience in preparing risk-assessments for a variety of events, which includes the ongoing maintenance of exhibits – such as PAT, or portable appliance testing.

7) Type of interaction

For presenter-driven interactives, this is less of an issue, though there are still useful things to consider here, regarding the *way* in which you (or others) might use the exhibit. Again, this is the briefest overview of a highly content-driven discussion.

- *Exhibit aim*

  Is it task-driven, designed that the user will navigate through a pre-determined chain of concepts? Is it an investigation: similar to the first, but with a target to aim for? Is it single- or multi-concept? This is often constrained by the intended use of the interactive. If it's for a public presentation then you may want to limit yourself to an easily stated (and then demonstrated) concept. For a workshop environment (or one where your interactive is part of a cluster), you may want to interweave a variety of related themes.

- *Use*

  The interactive may be intended for individual use, or may require several participants. It may be used as part of a workshop, or in a hall, in front of an audience. These considerations will define the way in which your interactive *presents* its results (another extensive subject for consideration), and on the basic interaction style.

- *Cycle time*

  This encompasses both the length of time that's to be spent on the interactive (by you or by users), as well as the underlying cycle time of the interactive itself, which may be entirely different. For example, a geosciences exhibit demonstrating carbon capture and storage has a minimum time of operation, while other exhibits may have a short usage time, but be intended to be used *several* times by a user. The type and extent of the

accompanying content is dependent on both of these times. Our experience has been that researchers will often design interactives that have a long cycle time, because they are building something that will demonstrate aspects of their own (and to them, very interesting) research work (and that they, understandably enough, want to pack full of content). In some environments, however, a long cycle time will not work, and the interactive designer can then be disappointed that their interactive is not having the desired impact.

8) Supporting materials

Another huge topic, and one which is most often ignored.

- *Additional graphics*

  Stand-alone displays

  These are often necessary at larger venues, such as festivals and other public events, to give a context for your talk (or the interactive itself), or to address broader issues. Such material is often themed to accompany an event, but the content is useful in a variety of circumstances. (UCAS and other university events make heavy use of this kind of material.) Designing this kind of content is often a useful exercise in preparing your interactive.

  Supplementary material for the interactive

  This may be part of the material above, or may be designed separately (and often will be themed to be independent of any event). This material augments or extends the aims of the interactive, and can be used by teachers as a springboard for further discussion or investigation.

  Additional material to hand out

  In the same way as the above, this material is useful for teachers, but also for those with an interest in your presentation or in the interactive. It prolongs the interactive's impact, and may be used to lead you audience on to other material.

- *Web sites*

  These are most useful to teachers and pupils, supplying a targeted (and vetted) series of links and material, to extend the usefulness of the original presentation. Curriculum links are always appreciated by teachers.

For more information on how FUSION can help you design and build your interactive exhibits, contact us at *fusion.group @ed.ac.uk*, or visit our website: *www.scifun.ed.ac.uk/fusion*.