Visitor Studies: Convincing the Director

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I have become convinced that visitor studies, especially formative evaluation, must be among the highest priorities of my institution. Not all directors feel this way. Directors must juggle competing priorities including collecting, conserving, publishing, maintaining exhibits, repairing the building, increasing visitor counts, and perhaps raising funds for a new wing. This essay is about how I came to hold the view that visitor studies are at least as important as any of these popular pastimes.

A director's priorities are based on the institution's mission statement. The mission of my institution is to communicate science and technology to children, teachers, and families. Essentially all museums' missions include educating the public.

How can my Board of Trustees and I measure our success in communicating with the public? By the square feet of exhibits we produce each year? By popularity? Square feet of exhibits or the number of visitors who pass through them are easy to calculate but are not very meaningful measures of how much we are actually communicating.

Formative evaluation is a type of visitor study, an iterative technique of measuring the effectiveness with which a working prototype communicates, and then revising that exhibit unit in accordance with the results. Formative evaluation supports our fundamental mission, but it is not cheap and it does takes time. It raises the cost and delays the completion of exhibitions which are already expensive and time-consuming to produce. Especially when money and time are tight (and they always are), is formative evaluation really essential?

Formative evaluation is certainly not the cheapest way to build exhibits. But I have become convinced that formative evaluation is the cheapest way to build *effective* exhibits. I have learned to give priority to projects which make use of formative evaluation, even if the cost must be paid for by making the exhibition smaller or reducing other aspects of its budget.

My conviction stems from twenty years of experiences in developing exhibits, both with and without formative evaluation. I'll give four real examples. In each case, plans had been drawn up by experienced exhibit designers, scientists, and educators, drawing on their shared knowledge, prior

experiences, and intuition. In each case, the team believed that the end result would effectively communicate science and technology to the public. Finally, in each case a director or exhibits director had to make the decision of whether or not to approve the expenditure of funds for that project, and whether or not to approve diverting some of those funds, perhaps 15 to 20 percent of the overall project budget, to pay for formative evaluation.

As I describe these examples, I invite you to consider whether you would have approved these projects as they stood, and whether you would have approved diverting funds to pay for formative evaluation.

Example 1: *The Roulette Table*

The study of chance—the statistics of random variations—is a part of fundamental modern mathematics, and has found major applications in such diverse fields as physics, astronomy, environmental science, and traffic engineering. There is evidence that most people have serious misconceptions about chance; for example, believing that chance is history-dependent. If you play roulette and odd numbers win 5 times in a row, it is tempting to assume that even numbers are "overdue" and that the next spin is less likely be won by yet another odd number. Mathematics would say that the chance of success remains exactly the same for both odd and even numbers, regardless of how many times odds have won in the past.

A novel exhibit to reveal these misconceptions and address them was proposed for the Cité des Sciences et de l'Industrie in Paris, as part of a large exhibition on mathematics. The proposed exhibit unit was a real roulette table, complete with red velvet chairs. This roulette table was equipped with computers, keyboards for each visitor, and monitors suspended overhead. Each of the visitors could select his or her own betting strategy from several choices. For example, you could instruct the computer to avoid numbers which had won recently, if you believed those numbers were "used up" and unlikely to win again so soon. Conversely, you could instruct the computer to bet on numbers which had won recently, if you believed those were "lucky" numbers.

The computer played several rounds of the game, betting for each of the visitors using the strategy selected, and showing the results of each round. The actual roulette wheel was not used. The computer would then quickly complete some additional rounds, in order to achieve a degree of statistical significance, and display the total gains and losses for each visitor.

All of the historical strategies gave approximately the same results as random betting, with slight statistical variations. An explanation of the mathematical principles followed.

Would you approve construction of this rather expensive exhibit? Would you add significantly to the ultimate cost of this unit by approving formative evaluation before the final installation?

Example 2: Telescopes And An Artificial Sky

The Lawrence Hall of Science in Berkeley, California, decided to develop an exhibition on the tools of astronomy. Telescopes are primary tools, and as with the mathematics exhibit described above, the exhibit staff knew that there were misconceptions about telescopes. Most people believe bigger telescopes magnify more, when in fact magnification is largely independent of a telescope's size. The one great advantage to bigger telescopes is that they make faint images brighter.

The exhibition plan called for real telescopes and an artificial night sky "window" mounted high above the exhibit floor. Visitors could try large and small telescopes, vary the magnification, use spectroscopes, and change the effective diameter of the light-gathering lens. A custom-designed telescope was commissioned. For ease of operation it had both coarse and fine adjustments for positioning, a finder telescope to help in aiming, and a right-angle viewing eyepiece. This type of eyepiece allows a visitor to bend over and look down into the instrument, at right angles to the axis of the telescope barrel, instead of having to crane one's neck back in order to look directly through the telescope—an uncomfortable position when the telescope is pointing at a high angle.

The exhibit designers had a sample of the special telescope constructed, and while it was expensive they were pleased with the quality of the image and the flexibility of the controls. They had concerns about the lack of realism of the artificial sky and whether visitors would perform the suggested experiments, but they were ready to produce nine more copies of the sample telescope.

As a director, would you approve the immediate purchase of nine more copies of the telescope, or would you require that additional time and money be expended in testing the concept through formative evaluation?

Example 3: The *Transformation Of Energy Machine*

For the energy theme in the children's area of the Cité des Sciences, a consultant proposed a modest-cost exhibit unit on the transformation of energy from one form to another. The device consisted of a hand-cranked electrical generator, connected through switches to half-a-dozen devices which converted the electric energy into various other forms. An electric toy train produced motion, a door bell produced sound, a light bulb created light, an electromagnet generated magnetism, etc. Children would be able to throw switches to connect each of these separately, or in any combination. As more devices were connected, the generator would become harder to turn, since so much energy was being consumed, demonstrating the principle of the conservation of energy.

Especially since this exhibit unit would be relatively inexpensive to produce, would you as the director approve going ahead to build one for the

exhibition, and moving on to more difficult and expensive units? Or would you insist on investing in formative evaluation of this unit?

Example 4: A Computer Tutorial On HIV-AIDS

The New York Hall of Science had developed a computer-based exhibit unit on the human immune system. Visitors could navigate through sections on anatomy, invasion of the body by various forms of germs, and the body's elaborate defense mechanisms. Each section featured written and spoken text, colorful cartoon-like graphics, animation, and sound effects. Evaluation indicated that the exhibit appealed to a wide range of visitors, and was effective in communicating basic information on how the human body protects itself.

The exhibit team then decided to develop a second unit, expanding on the biology behind HIV infection and the AIDS disease. A key goal was to address established misconceptions about HIV, such as the notion that any form of birth control provides protection against infection during sexual activity. Once the virus' infection route is understood, it becomes apparent that only condoms or abstinence can provide that protection.

The exhibit designers completed the new unit, using the same style of presentation as the earlier, more general exhibit. Some team members questioned whether the highly stylized, cartoon-like representation of the human body, which was used successfully in the earlier exhibit, would remain adequate for this topic. Would more realistic drawings of human sex organs and intercourse be necessary to change the widespread and potentially deadly misconception? Or would the stylized graphics communicate just as well, and avoid potential visitor complaints? As a director, would you decide to undertake the time and expense of testing with visitors, and perhaps developing an alternative version for comparison?

The Results

In each of these four examples, the directors or exhibit directors involved elected to expend funds for formative evaluation, although in some cases the director's intuition agreed with that of the exhibit team, and it was suspected that little would be learned for the expense of formative evaluation.

In all four cases, however, as in nearly every instance of formative evaluation I have studied, major surprises were in store for the exhibit team.

The *Roulette Table* proved highly attractive, yet highly ineffective. Visitors were disappointed to discover that the actual roulette wheel was not being used, and that the computer simply gave the results. Watching the wheel spin and the ball drop had great attraction for visitors, and was missing here. Of more fundamental importance was the visitors' attention to who actually won the most, regardless of strategy. Since random chance

inevitably made one strategy win a little more (or lose a little less) than another, visitors felt their strategy had been vindicated if they came out a little ahead. Few stayed to read the text on mathematical principles. This exhibit was deemed ineffective, and not likely to be improved significantly by minor alterations.

When the custom telescope was first tried it appeared to be a success. Exhibit designers asked visitors to look at the sky window through the telescope and nearly all visitors succeeded, even though it took nearly a minute of playing with all the controls to aim and focus the telescope. However, when the telescope was left on the exhibit floor without staff standing nearby to encourage visitors to try it, a very different conclusion was reached. Nine out of ten visitors gave up within 20 seconds of trying unsuccessfully to operate the telescope. Too many controls confused visitors. The right-angle viewing device made visitors unsure where the telescope was pointing. Without the staff member standing by watching, visitors apparently decided this device was not worth the effort of learning to use it. Modifications and instructional signage for the telescope were tried, but these brought little improvement. Finally, the custom design was abandoned, and a much cheaper, less flexible, less comfortable, but more intuitive operating design was selected. Nine out of ten visitors succeeded in making this new telescope work within 20 seconds, and stayed on to complete the intended learning activity.

The *Transformation of Energy Machine* was attractive, and visitors reported learning from it—but not learning what the designers had intended. When both the bell and the train were connected, for example, the young visitors reported that they had discovered that the bell was a speedometer, ringing louder the faster the train ran. With all the switches closed, the generator became harder to turn, and visitors decided it was malfunctioning. The generator was regarded simply as a device to turn the exhibit on; none of the visitors seemed to have learned anything about energy transformation. Many young visitors did not understand how the switches functioned, and just assumed the exhibit was broken when they spun the generator and nothing happened. The exhibit designer reluctantly concluded that this exhibit tried to do too much in one unit. The topic would be better approached with a series of generators, each connected permanently to one or more of the energy consuming devices—a much more expensive but also more effective design.

The *HIV-AIDS* exhibit unit did communicate some of the basic biology of the virus, but in its original form the exhibit made only a modest impact on the widespread misconception that all contraceptives can prevent transmission of the disease. A more explicit depiction of intercourse was then produced and tested. While still not approaching photographic realism this version resulted in a major improvement in visitor understanding. Twice as many visitors left with the correct understanding of the relative efficacy of condoms versus other means of birth control in preventing the

transmission of the virus. For example, acceptable answers to a question on condoms versus diaphragms rose from 22% to 45% of the visitors tested. (For a more detailed description of formative evaluation of the *HIV-AIDS* exhibit, see Falk & Weiss, this volume.)

The Limits Of Intelligence, Experience And Intuition

Some exhibit designs surely do work well the first time. In the absence of visitor studies, however, we never know whether they work or not. As the examples above demonstrate, even talented, experienced exhibit teams may sometimes produce designs which, after visitor testing, prove to be ineffective, frustrating, or even counter-productive in communicating with visitors.

Had the directors or exhibit directors approved each of these exhibit units as originally designed, the resulting exhibits would have given the expected value in terms of exhibit square footage produced per dollar. They would, nevertheless, have given very poor value in terms of science and technology communicated per dollar. Formative evaluation allowed ineffective exhibits to be abandoned, or transformed into effective exhibits.

Repeated experiences like these have convinced me that visitor studies are primary, high priority management tools. We use front-end and formative evaluation whenever possible, for both static and interactive exhibits, for demonstrations, and for education programs. Visitor studies allow me to be accountable in making sure that the institution uses all of its resources of time, talent, and funds in the most efficient manner.

Secondary Benefits

Evaluation also has important secondary benefits for directors and managers:

1) Evaluation can keep all staff focused on how we affect visitors, rather than on the myriad of other priorities that vie for the time, money, and passions of museum personnel.
2) Evaluation encourages teamwork, because prototype construction and statistically significant visitor testing are difficult to perform solo.
3) Evaluation helps visitors feel they are engaged in creating the museum, rather than passively viewing the offerings of remote scholars.
4) Evaluation in a science museum keeps the staff actively using the methods and values of science, rather than just talking about those methods and values.

The Bottom Line

The most fundamental value of visitor studies lies in its relevance to the mission of the institution. Balanced budgets, happy trustees, contented

staff, and proud funders are all highly desirable, but none of those outcomes are in the mission statements of our institutions. Changing the visitors by helping them to gain curiosity, to question, and to learn—those outcomes are what the mission statements demand. Visitor studies allow us to maximize the realization of those outcomes, and to know when we are succeeding in fulfilling the mission.