VISITOR STUDIES: CONVINCING THE DIRECTOR

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I am a museum director who has become convinced that visitor studies, particularly the type of research known as formative evaluation, must be among the highest priorities of my institution. Not all directors feel this way. There are other attractive priorities, including collecting, conservation, publications, maintaining exhibits and the building, increasing visitor counts, and raising funds for a new wing. This essay is about how I became convinced that visitor studies are at least as important than any of those popular pastimes.

A director's priorities originate the institution's mission statement. The mission statement of my institution is to communicate science and technology to children, teachers, and families. Most museum mission statements include a similar goal of public education.

How can the 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 the visitor studies technique of measuring the effectiveness by which a working prototype communicates, and then revising that exhibit unit in accordance with the results. The process relates to our fundamental mission, but it is not cheap and takes time, both raising the cost and delaying the completion of the already expensive and time consuming process of creating exhibits. Is formative evaluation worth the cost?

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.

What has convinced me of the value of this technique are the 20 years of experiences in developing exhibits both with and without formative evaluation. I'll give four real examples, drawn from museums in Europe and the United States. In each case plans had been drawn up by experienced exhibit designers, scientists, and educators. They carefully applied their knowledge, prior experiences, and intuition in coming up with these plans. They then presented to their directors exhibit units which they believed would be effective in communicating science and technology to the public. Finally, 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 to pay for formative evaluation.

As I describe these examples, I invite you to consider whether or not you would have approved these projects as they stood, and whether you would also have approved diverting a significant sum, perhaps 15 to 20% of the project's budget, in order to pay for formative evaluation. Then I'll discuss what was actually decided and the eventual results of those decisions.

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. Many believe, for example, that it is history dependent: if in a game of roulette odd numbers win 5 times in row, it is tempting to assume that even numbers are "overdue" and the next spin is less likely to yield yet another odd number. Assuming the wheel is properly constructed, mathematics would say the chances of success remain exactly equal for even and odd numbers, regardless of the previous history of the winners. Ten odd winners in a row are exactly as likely as ten alternating odd and even winners in a row.

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 Monte Carlo style chairs. This roulette table was equipped with computers, with keyboards for each visitor set within the table, and monitors suspended overhead. Each of the visitors could select his or her own betting strategy from several choices. For example, if a visitor believed that recent winners were "used up" and unlikely to win again, the computer could be instructed to avoid those numbers. Conversely, if a visitor believed that recent winners were "lucky," the computer could be instructed to bet on those numbers.

The computer played several rounds of the game, betting for each of the visitors using the strategy they had selected, and showing the results of each round (the actual roulette wheel itself was not used). The computer would then quickly complete some additional rounds, in order to achieve a degree of statistical significance, and then show how much each visitor had won or lost in total. 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 they were serious 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 diameter of the lens. A custom-designed telescope was commissioned. For ease of operation it had both course and fine adjustments for positioning, a finder telescope to help in aiming, and a right-angle viewing eyepiece. The latter device 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 an awkward position in order to look directly through the telescope when it 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 allow additional time and money to be spent 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 doorbell 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 move on to consideration of more difficult and expensive units, or would you accede to staff requests to invest 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 decided to develop a new exhibit unit expanding on one area of the earlier unit, 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. Once the biological characteristics of this virus' infection route are understood, it becomes apparent that only condoms or abstinence provide protection.

The exhibit designers completed a unit, using the same style of presentation as the earlier, more general exhibit. The question was raised as to whether the highly stylized, cartoon-like representation of the human body, which was used successfully in the earlier exhibit, would remain adequate for this one 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? Was it worth the time and expense of testing with visitors and perhaps developing a second version for comparison?

THE RESULTS

In each of the four examples, the Directors or Exhibit Directors involved agreed 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, but 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 or lost the most, even if the differences were small. Since statistical variations 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.

In the astronomy exhibit, 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 through it took nearly a minute of playing with 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. 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 made little improvement. The custom design was abandoned, and a much simpler, less flexible, less comfortable, but more intuitive operating design was selected. Nine out of ten visitors succeed in making this new telescope work within 20 seconds, and stayed on to complete the learning activity intended. The exhibit ultimately used ten telescopes of this design, which has been replicated by several other museums.

The transformation of energy machine was also an attractive unit, and visitors reported learning from it: but not learning what the designers 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. Indeed, turning the generator faster would make both more active, so the bell was indirectly a form of speedometer. With all the switches closed, the generator became hard to turn and visitors decided it was malfunctioning. The generator was regarded simply as a device to turn on the exhibit; none of the visitors seemed to have gained any concept related to energy transformation. And 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 a more effective design.

The HIV-AIDS exhibit unit did communicate some of the basic biology of the virus, but failed in its original form to make much of an impact on the widespread misconception about the ability of all contraceptives to prevent transmission of the disease. A more explicit depiction of intercourse was tried, and while still not approaching photographic realism, this version made 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, correct answers to one question on condoms versus diaphragms rose from 22 percent to 45 percent of visitors tested.

THE LIMITS OF INTELLIGENCE, EXPERIENCE AND INTUITION

Some exhibit designs surely do work well the first time. In the absence of any visitor studies, however, we may never know whether they work or not. But 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, at reasonable cost.

These experiences are what convinced me, as a museum director, that the expense of visitor studies, particularly for formative evaluation of both exhibits and programs, are primary, high priority tools. We use 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 resources, of time, talent, and funds in the most efficient manner.

SECONDARY BENEFITS

Visitor studies and evaluation also have 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 view for the funds, time, 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 abut those methods and values.

THE BOTTOM LINE

The ultimate value of visitor studies comes from their relevance to the mission of the institution. Balanced budgets, happy staff and trustees, 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 question, to learn, and to gain curiosity--those outcomes are what the mission statement demands. Visitor studies are a way the director and staff can maximize the realization of those outcomes, and know when we are succeeding.