

PROBLEM SOLVE
OVERHEAR
INTERACT
REFLECT
REMEMBER
ANALYZE

OBSERVE
CONNECT
COMMUNICATE
RECORD
ENLIGHTEN
MANIPULATE

EXPERIMENT
ASSOCIATE
EXPLORE
PROBE
EXTRAPOLATE
INTENSIFY

INTEGRATE
NOTICE
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WONDER
IDENTIFY

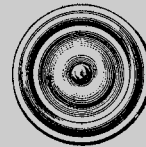
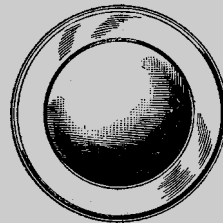
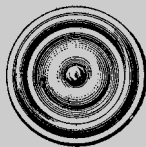
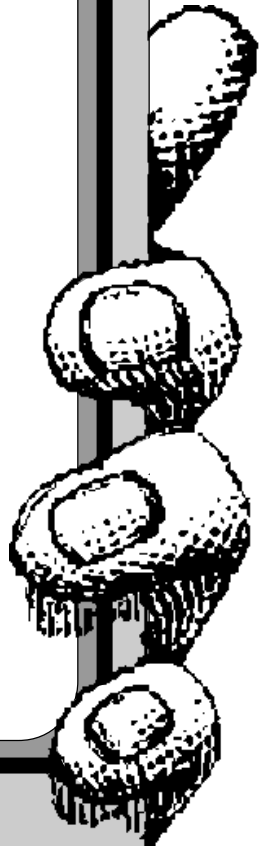


Electronic Guidebook Forum

October 11 - 12, 2001

San Francisco, California

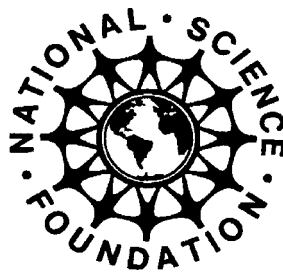
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the museum of science, art
and human perception



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This unpublished document is intended to be a faithful synthesis of the discussions that took place at the Electronic Guidebook Forum held at the Exploratorium, San Francisco, October 11 - 12, 2001. It is meant to serve as a resource for those who attended as well as others in the field, and it does not necessarily reflect the views of the Exploratorium or of individual symposium participants.

Participant comments have been paraphrased. These are not exact quotes, rather they are an attempt to capture the content and meaning of the ideas presented.

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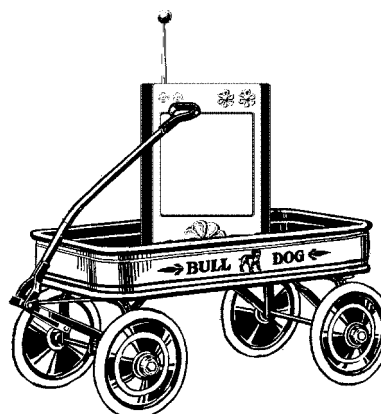
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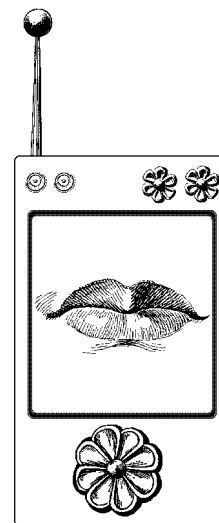


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I. OVERVIEW

A. The Forum

Participants, Process and Goals

This two-day forum brought together researchers and developers from industry, academia, and the museum world for discussion of the latest findings on the application of handheld computers and wireless networks in museum exhibitions.

Forum content centered on interrelated aspects of electronic guidebook projects in museums and on emerging questions from the field. The format included full group discussion of these topics, as well as discussion in small groups on lessons learned and recommended next steps.

The goal of the forum was to identify key issues that will inform further work in the museum field on wireless handheld devices and stimulate research and implementation.

Beginning Groundwork

The forum did not, nor was it expected to, result in a template or a how-to manual concerning implementation of nomadic computing projects in museum settings. The forum did underscore the fact that this is a new field in the early stages of evolution, based on emerging, rapidly changing technology.

The candor and honesty of the projects that shared early findings, results, and visitor feedback about their research and deployment efforts was noteworthy and contributed significantly to the forum discussions.

Those discussions resulted in recognition of the varied potential of nomadic computing in museums settings, and identification of challenges, issues, commonalities in problems, and intriguing questions. The result is an understanding of the beginning groundwork and a set of questions that may serve as pointers for museums continuing projects in progress, museums about to launch electronic guidebook projects, and museums just beginning to think about the potential nomadic computing may hold for their particular context.

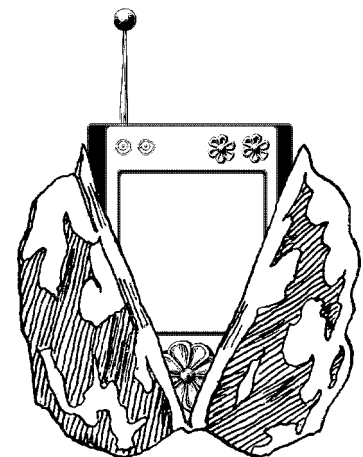
Ongoing Dialogue

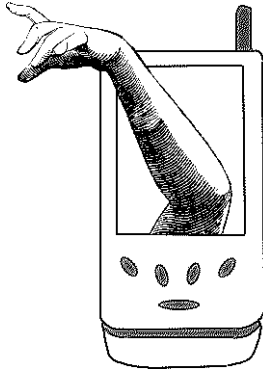
Forum participants appreciated the excitement and opportunities inherent in assuming pioneering roles in what is a raw and largely unexplored landscape. Participants also expressed a desire to continue the discussion and information exchange on an ongoing basis and to track the progress of participating museums over time. Rather than

Questions

Participants were asked to consider the following questions prior to the session. The questions then served as a focus for discussion during the forum.

- Which aspects of using handheld computers in museums do you find most promising?
- Which aspects concern you the most?
- What unanswered questions do you have about using this technology in museums?





Sample Projects

Presentations and demonstrations from electronic guidebook projects, including those in a research phase and those in full deployment, offered insight into initial findings in the field, highlighted the promising aspects of introducing nomadic computing to a museum setting, and helped to surface common problems, challenges, and questions.

The projects represented a spectrum of contexts including a science, art, and human perception museum; a children's discovery museum; a historic house; a museum of world culture; a modern art museum; and a probeware project that works in both museum and formal education settings.

convening sessions as an adjunct to exhibiting museum association meetings, it was felt that this should remain a separate forum, one that represents a diverse group composed of industry, academics, and a cross-section of museums, forming a learning community in a new domain.

B. Sample Projects

Points of Departure - San Francisco Museum of Modern Art

www.sfmoma.org

www.sfmoma.org/exhibitions/exhib_detail/01_points_of_departure.html

Making active use of new technologies and multimedia education programs, this exhibition presented works from the museum's permanent collection that can be inaccessible, confusing, or disturbing to visitors, organized in six curatorial themes. Video clips of artists talking about their work were presented on the iPAQ Gallery Explorers. In each gallery, information kiosks called "Smart Tables" featured introductions to the exhibition's themes and video clips of artists and curators discussing the work. The exhibitions also included Making Sense of Modern Art – the Museum's flagship multimedia program, with new content developed especially for Points of Departure – and Make Your Own Gallery, which invites visitors to organize their own exhibitions.

Sotto Voce - Xerox PARC

<http://www.parc.xerox.com/guidebooks/>

Sotto Voce is a prototype developed and evaluated at Xerox PARC. Sotto Voce employs a user interface based on imagemaps and an interaction technique called "tap tips." Tap tips are transient highlights that indicate imagemap targets as needed. An outline appears around targets if you miss a target. To mitigate the potential problem of visitor isolation, the handheld device includes the opportunity to eavesdrop on a companion's guidebook so that visitors can share information, thereby increasing social interaction. Sotto Voce has been tested in several rooms at Filoli, a historic house in Woodside, California (<http://www.filoli.org/>).

Kid Club Communicator - Port Discovery

www.portdiscovery.org/

Port Discovery is a children's museum in Baltimore, a hands-on, skills-oriented museum in which children learn to cooperate, problem solve, and communicate, with exhibits designed by Walt Disney Imagineering. Wireless handheld devices called Kid Club Communicators (RIM Blackberry Pagers donated by Aether Systems) utilize custom software and enable increased interaction and problem solving activities with exhibits. The communicators have e-mail capacity and there is a two-way pager – a highly popular feature with kids.

MUSEpad - Mathers Museum of World Cultures

www.archimuse.com/mw2001/papers/kirk/kirk.html
www.indiana.edu/~mathers/new/index.html • www.worldboard.org
Mathers Museum, in partnership with Information in Place, Inc. and others, engaged in a six-month NIH feasibility study to determine whether a mobile computing tool called the MUSEpad that uses emerging WorldBoard technology could serve as a useful device for people with disabilities. WorldBoard, which represents a convergence of technologies, utilizes wireless connectivity and positioning systems to enable visitors to access Web-based information correlated with physical locations or objects.

The interest was in customization of content for different users, specifically those with low vision, low hearing, and mobility problems. The study created user profiles, utilized exhibit spaces at Mathers Museum (a museum of anthropology) as the focus for content, developed “channels,” or different modes of developing content (audio, video, etc.), and investigated authoring kits.

Findings, which relate to both features and functionality, include audience preference for larger screens, the audio mode of delivery, and manual control versus auto updating. Video clips (watching a craftsperson at work, rotating an object 360 degrees) were a popular feature. Audience requests included the ability to bookmark, wheelchair mounts, customizable “skins,” access to objects not on view, ability to record and retrieve information after the museum visit (“my museum”), and paging capabilities.

Concord Consortium Probeware

<http://concord.org/ccprobweare/guidebook/slide1.html>
<http://concord.org/data-models/conductivity-system.html>
<http://concord.org/ccprobweare>

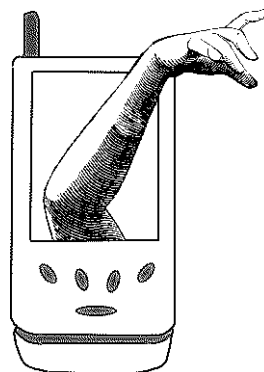
The Concord Consortium (CC), a nonprofit educational research and development organization, is one of the partners working on the Exploratorium Electronic Guidebook project. One Concord Consortium focus is on sensors, modeling, and handhelds. Other work includes online learning and professional teacher development. Work on the Electronic Guidebook project involves exploring the use of sensors in a museum setting – for example, building sensors into exhibits, with data displayed on handheld computers. Other CC projects contributing to the development of CCProbeware include the Data and Models project, TEEMSS (Technology Enhanced Elementary and Middle School Science), and modeling across the curriculum.

Electronic Guidebook Project at the Exploratorium

www.exploratorium.edu/guidebook/
<http://cooltown.hp.com>

The Electronic Guidebook is a research project investigating the use of handheld computing devices and wireless networks to support a richer learning experience for science museum visitors. In collaboration with the Concord Consortium and Hewlett-Packard Research Labs, with funding from the National Science Foundation, the Exploratorium is testing a network of mobile devices, wireless systems, and Web-based content that supplements the museum’s interactive science exhibits. The goal of the project is to develop a knowledge base on how this network will allow individuals and groups to engage in a continuum of activities before, during, and after a museum visit to support a deeper engagement with the exhibits.

Activities include applying H.P.’s CoolTown concepts, testing various technologies applied to the museum environment, prototyping user interface components, and investigating the potential to increase visitors’ learning experiences.



C. Summary of Key Lessons, Ideas, Issues, & Questions

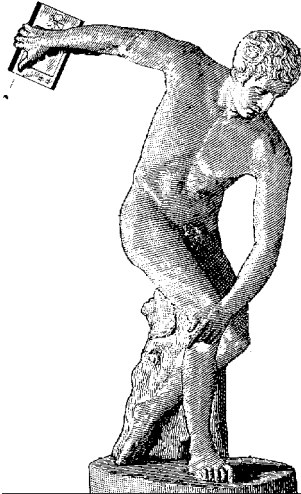
During the two days of presentations, discussions, and work groups, a rich spectrum of ideas, questions, and concerns emerged that may assist in guiding future research, provide valuable background for museums in the early stages of thinking about introducing nomadic computing to their environments, and serve as useful pointers for those actively engaged in planning and deploying handheld devices in a museum setting.

A summary is provided here and an attempt has been made to categorize the ideas that surfaced. However, there are understandably many overlapping issues. Most notably, questions and issues listed under discrete categories could also be easily translated to fit within the research and evaluation category as well.

The Potential

A Visitor Tool For Reflection, Creation, Input

More exploration is needed to investigate the potential of portable devices as a visitor "notebook." How would this work? What motivates the visitor to contribute their own knowledge? How much will visitors contribute? When? In what forms?



Overarching Issues For Museums

Institutional Mission, Goals, and Objectives

- Why do this? Does this add fundamentally to what the museum is trying to accomplish?
- This should be museum-driven rather than device- or technology-driven. How does this fit into the way your museum encourages new ideas and projects?
- Be very clear about your objectives: are handhelds the best way to meet those objectives?

Return on investment

- Assess the investment versus the payoff. The investment is considerable, both for the museum (in terms of staffing, technology, content development, etc.), and for the visitor (learning to use the device, spending time with the device). Will the return on investment justify the effort?

A Customized Individual Visitor Experience

How can these devices be used to enable a personalized experience tailored for the needs and interests of the individual visitor so that every visitor feels like a VIP? What does this mean? How do we want this to happen? When and where? Will content be shallow or in-depth? Will it stretch into the pre-visit and post-visit domains?

A Channel For Different Voices, Diversifying Sources of Content

Via use of portable devices, it is possible to diversify the sources of the content the visitor receives on a museum visit. For example, a scientist, an artist, and a ten-year-old talking about the same interactive science exhibit. The idea is that different voices would model learning about an exhibit from diverse perspectives.

Access & Enhancement For People With Different Abilities

There is the ability to enhance the museum experience in the moment in a way we wouldn't otherwise be able to do, particularly for people with different abilities.

An Expanded, Multifaceted Role For Visitors

Equipped with this device, the visitor can become a curator, a researcher, a content provider.

Enabling an "Aha!" Experience and Stimulating Further Exploration

Ideally, the device should further what the museum is attempting to accomplish. How can the device help people to pay attention, to have an "Aha!" experience that stimulates them to explore the exhibit or subject in depth?

A Mediator, Manager, Meaning Maker

The device can enable the visitor to record, reflect, make meaning, make connections between exhibits and, potentially, between experiences at different institutions and between the museum and the outside world. Ultimately, the device could be a personal "notebook" that is attached to the visitor rather than to the museum; something that is embedded in the visitor experience rather than an individual museum's philosophy and ideas.

A Take-Away Experience That Extends Beyond the Museum Visit

Because the devices have the potential to access the Web and create personalized pages on the Web, the experience can extend to the classroom or the home computer after the visit. An example of this in operation is the Exploratorium Electronic Guidebook project's incorporation of personal Web pages for visitors, called "My Exploratorium Scrapbook," which can be accessed during the visit as well as during pre- and post- visit experiences.

A Catalyzer for Social Interaction

While there is concern about the negative potential of handheld devices in terms of isolating the visitor, the potential for the use of handhelds as catalyzers for face-to-face interaction also exists. In the Xerox PARC Sotto Voce project visitors could "overhear" what a companion was doing with the device, and visitors observed that the device became a third party in conversations. At Port Discovery, visitors can electronically communicate with each other via instant messaging. Other socializing aspects might include dual earphones. SFMOMA considered incorporating a screen visible to other visitors so that others can see what you are exploring and potentially come over and strike up a conversation.

Extend Your Observational Capabilities, Create Your Own Data

There are devices (e.g., probes attached to handhelds) that allow you to extend your observational capabilities and create your own individual data, to keep track of what you've learned, to build data about who you are.

Increased Interactivity With Exhibits

Introducing the virtual realm enables visitors to "touch" objects they wouldn't otherwise have access to; to see a 360-degree view of an object; to flip through the pages of a rare book; to see what a painting would look like in a different color or style.



The Audience

- Who is the audience?
- What impact does the age of the visitor have? Are the applications/approaches we are using multigenerational regarding access? How do demographics of the audience affect the audience experience?
- How do we accommodate casual, drop-in visitors with one of these devices?
- How much training does the visitor require? How much can you assume about visitors' technological savvy?
- To what degree are our goals audience-driven?
- How will we use the capacity to gain input from the audience? As an evaluation tool (e.g., rating an exhibit)? As a legacy of information, experiences and insight that become part of the museum experience?
- Do these devices isolate the visitor or enable increased socialization?
- Does visitor data collection invade visitor privacy?
- Does the procedure for checking out a device (e.g., credit card deposit) create an economic barrier?
- Have language and other access issues been addressed?

Management, Staff, and Operation

Lessons Learned

Set Clear Goals and Objectives

- Be realistic regarding expectations
- Gain management buy-in

Assemble A Team

- Assure your team includes the necessary skills (UI designer/graphic designer; content developer; museum educator; exhibit developer; visitor advocate; participant designer; program manager/decision maker).
- Team must include someone with ability to make decisions for the team and the project.
 - Include stakeholders from the beginning (e.g., maintenance, visitor services, docents).
- Communication between team members is key.

Adequate Resources

- Assure adequate resources for staffing, equipment, and content development. Trying to do a wireless project with less resources than you need will make it twice as hard. Put enough resources into content – this isn't just a technology project.

1. Concerns

- Developers need a variety of skills (knowledge of exhibits, interface design, programming, etc.) and you want those working on development to have as wide a range of skills as possible.
- Maintenance concerns include having adequate staffing for ongoing maintenance, and budgeting for spare equipment so that you have replacements when equipment is broken or goes down.
- Concerns regarding adequate staffing, commitment, and team work include the observation that you need at least one team member working more than 50% of their time on the project. Assembling many team members who can only dedicate 10% of their time doesn't work.
- Who will be distributing, supervising, overseeing use of devices on the floor? Don't assume your front line staff will take this on; they're already overloaded.
- Staff training will be required. Include staff training as part of your overall plan.
- The practice of requiring visitors to give their credit cards to check out the devices raises concerns regarding the security of the credit card information.

2. Questions

- What impact will a wireless guidebook system have on the role of docents? This could be an opportunity – the devices could serve as conversation provokers that stimulate visitors to interact with docents. Some docents might see it as a threat, interfering with their role. There is a need to involve docents in addressing these questions from the early stages.
- How does this affect visitor paths through space? Have crowd control issues been considered?
- Can this be integrated with the existing network of the institution? Are there opportunities to integrate this with ticketing, the call center, the museum store?

Collaboration - Issues and Potential

- The collaborative possibilities posed are exciting.
- Clarify protocols for collaborative relationships.
- Address intellectual property issues.
- Recognize the potential tension in test projects between a museum's mission and industry research; a museum's desire to meet its own goals in a cost-effective way and an industry's desire to push the field.
- Are there existing models for developing in partnership, (for audio guides for example) that would make sense here?

- Are there marketing opportunities related to branding; things that could affect the business model?
- Can this be used internally to increase communication among staff members, particularly between floor staff and office staff?
- Can this be coordinated with those who have responsibility now for updating exhibits - with the public programs department of the museum?
- How do you make this a permanent part of your budget, including ongoing evaluation?

Technology

Choices

Is A Mobile Device What You Need?

- Make sure a mobile device is what you need.
- Is there another way to accomplish your objective?
- Consider the alternatives.
- Benefit to user must outweigh the cost (inconvenience, learning curve, limits to social interaction).
- Use a handheld device only when it is the most effective way to reach your objective, and be very clear about your objective.
- Don't use handhelds for things that already work well (e.g., if you have a scavenger hunt activity that works well with clipboards, why use a handheld?).
- Be willing to admit when it doesn't work well (which is not up to you, but up to the visitor).

Selecting Appropriate Technology and Applications

- How will this integrate with your existing network? If you plan to integrate, assure that your existing network is stable and well documented. An alternative is to skip integration with the existing network and start new.
- Don't use bleeding edge technology in the deployment stage.
- Use technology that works - visitors won't cut you a lot of slack.
- A mundane but important point - tethers and fanny packs or alternative methods for assuring that visitors can tote the equipment around and still have use of their hands for interactive exhibits.

Ubiquitous Versus Portable

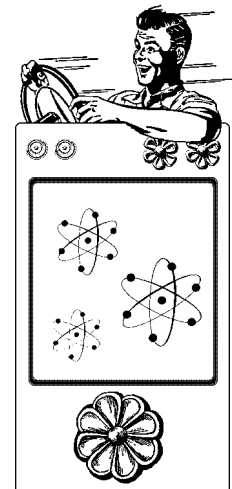
- Articulate the differences between ubiquitous and portable; between computing devices everywhere (with presumably larger capacity), and portable, more limited and fragile devices that the visitors carry with them. Which best meets the goals your museum is trying to achieve?

The Larger Context

- The end configuration may be a combination of technology devices or a combination of technology and non-technology. The end design should fit into the larger context of your museum in terms of both the museum's mission and its physical environment.

Promise

- Information storage on the Web - deciding what you want to store locally and what you store globally.
- What potential is there for networking between museums?



"First, what success have you had in focusing the use of the tool to address only a few questions well? Second, what success have you had in developing a global system of stimulation to deepen the access of people to this environment?" • Goéry Delacôte, Executive Director, Exploratorium

Coping With Rapidly Changing Technology

- While there was general agreement on the wisdom of avoiding "bleeding edge" technology in this rapidly advancing field, questions remain about where the museum should jump in, how to make the wisest investment, how to deal with rapid obsolescence. One solution was to budget in advance for rotating new units in on a staggered basis.
- How does rapidly changing technology affect goals and objectives? It's possible to do things now with technology that weren't possible five years ago. There's going to be a tension for some time between technology and goals and objectives.

Concerns & Questions

- Variations in user Web configurations
- Rapid obsolescence of technology
 - The need to plan for resources to maintain the infrastructure. Can you fix it when it breaks?
- Bandwidth capacity and scalability. What happens when a lot of people use it all at once?
 - Battery life
 - Ergonomics
 - Robustness, durability
- Relationship between the device and the network
 - Security of your infrastructure
 - Security and privacy regarding visitor information
- Interoperability - across devices and across museums
 - Are different devices needed for different types of museums?
 - Are we designing for single or multiple users?
- How do you manage the information this technology is capable of collecting from visitors?

Ideas and Potential

- Enable visitor input to the information base, to build an active role for visitors.
 - Work on using these devices to increase social interaction is promising, whether that may involve paging capabilities, the ability to “overhear” what another visitor is doing, having two earpieces on a device, etc.

Lessons Learned - Important Considerations Design and Development

Apply The Basic Rules of Design

- Start at the beginning, look at the environment, focus on the use of the device within the space.

The Importance of Prototypes

- In early stages use paper prototypes or low fidelity prototypes.
- Be clear on the difference between prototype activities and prototype technology (you can test activities prior to investing in technology).
- Test the simple things first.
- Consider making prototyping part of the visitor experience at the museum, which establishes your museum as an innovative place.

Simplify, Eliminate, Minimize

- It's important to select a minimal set of features you're going to address; make it good at a few things.
- Avoid "feature creep" - just because a device has capabilities does not mean you should use them.
- The focus is not on the device, it is on the objectives you want to realize.

Vertical or horizontal design and goals

- There is the vertical arrangement, in which the electronic device is part of the design of an exhibit. There is the horizontal arrangement, spanning across the whole museum so the visitor carries the device across different settings. Be conscious of the choices you make between vertical and horizontal design.

User Interface

Concerns

- How do we assure that the technology is transparent and easy to use?
- Does the technology interfere with the experience? How can this be avoided?
- How do we avoid technoisolation – visitors walking around, headphones on, heads down?
- Does the digital divide mean those who are technologically savvy will benefit while those who aren't will not?
- Are we confusing the devices with the general problem? For ideal design, we need a general theory of the problem and appropriate use of technology.
- Ensure good visibility of the display in a range of settings.

Questions

- Are different applications required for different settings or is there one universal approach that will work for all? How do age and gender issues affect this question?
 - How do you design a user interface that will work on different systems (from portable to larger systems, from small to large screen)?
 - Are we talking about ubiquitous computing or highly mediated experiences?
 - What voice or personality will be used – the omniscient voice of the museum or something more personal?
-

Content

Concerns

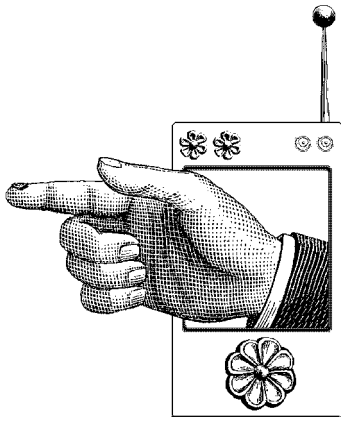
- There is a difference between conveying information and process skills. Is there a context for integrating that information?
- How do age, gender, technological savvy, individual abilities affect how much visitors gain? Affect content development?
- Can we go beyond information content to enable visitors to conduct their own research, collect their own data, reach their own conclusions? In some exhibits, this may be as simple as user-added data.
- Idiosyncratic information about users and exhibit developers contributes to the charm of the experience with the Exploratorium's Electronic Guidebook. How can this idiosyncratic charm be maintained in a museum with limited staff or on a project with high expectations?
- Related to the above question, who designs the content? What if an artist was involved in designing the handheld interaction in an art museum?
- Regarding who designs the content, is it exhibit developers or software people? There is a need for software that exhibit designers can use.
- There is the danger of two content streams: general visitor content versus research content. Make sure that the two groups talk to each other.
- How do we maintain, upgrade, renew content over time?

Questions

- How do you choose the content? How do you choose the best format (text, audio, video) for content delivery?
- Do you layer this on top of old exhibits, or start from scratch, designing new exhibits with this in mind?
- Is this a tool for conserving old knowledge, or for the changing, shaping, and innovation of knowledge?
- There is a lot of information out there. How do we select what is interesting or engaging?
- How does this relate to state education standards and benchmarks? How much will they drive content development?

Promise/Potential

- There is potential for flexibility in content, for using existing content on Web pages, for creating new content.
- It's possible to develop customized content that can meet user interests and needs upon demand.
- What happens in the space between the physical and the virtual world? What are the possibilities for designing in the space between, for developing interactive content that pushes back and forth between the two realms?
- The scope and nature of information you are able to offer visitors extends far beyond that of the average museum catalog.
- In addition to offering visitors a tailored, individualized experience, the visitor can build on previous experience in repeat visits. You can also remind the visitor to come back.
- You can have experiences across physical space (e.g., between two rooms) and across the connection between virtual and real space.
- You can use the exhibit as a base for further learning, whether formal (in the classroom) or self-taught.
- You can integrate live content and create on the fly.
- There is profit potential: you could have links between content and items for sale in the museum store.



Promise/Potential

- These electronic guides offer a way to gather information and feedback that can be used for rating exhibits and for making associations between exhibits.

- How in-depth will the content be? For example, do we include complicated scientific papers? How much do we need to mediate the content? How much original material will there be, how much mediated, and how much repackaged?
- How much capacity do museums have for generating new content? Is it possible to scavenge existing content?
- Who owns the content? What intellectual property and copyright issues are involved? How will this affect sharing of content between museums, and between museums and other institutions?

Research and Evaluation Questions

- What does the visitor think (and how do we find that out)?
- What impact does this have on visitor behavior? Does this change their perceptions? Does the device improve their experience?
- What device works best? How far can we drop it? What is the killer application?
- To what extent does this stimulate understanding and inquiry?
- Does use of this technology enhance retention of experience or knowledge after visitors leave the museum?

Methods, Approaches

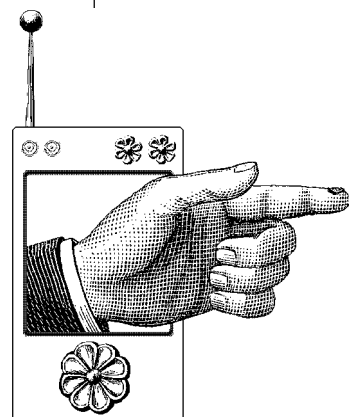
- How do you get access to the data that exists?
- How can we build on or link to what is already known or has already been researched about nonnomadic visitor experience so that we can improve practice and increase knowledge in general?
- Can we use marketing research techniques, specifically online demographic research, to understand audience use of information?
- How does the research and evaluation feed into exhibit design?
- Currently we are thinking in terms of case studies. As this matures we will see categories of intentions and categories of place. We are in the early stages of the process of developing the taxonomy, of seeing the patterns.
- Can you apply existing research methods and evaluation techniques to a field that hasn't really existed before?
- Because we start designing these systems without knowing what the research questions are, we need to make sure that we capture enough data to recreate the situation.
- Concerning the visitor experience, how do you capture, measure, quantify, or express differences in quality? How do you measure impact over time, the effect on the visitor years after the museum experience?

- What is the validity/effectiveness of the pre-visit experience versus experiencing an exhibit cold?
- What are the indicators of success regarding visitor experience? Does extended time spent with an exhibit improve visitor interaction with the exhibit? How important is retention? They might remember something, but does that mean they had a better experience?
- How will the data that is collected affect the museum? How will information about the people who come to the museum and how they move about the museum influence the museum itself and the way the museum is organized?
- There may be a lot of research and information that exists regarding video, audio, and text in fixed installations. The difference here is that it's portable. What difference does portability make?
- How does personalizing or customizing the experience for visitors affect the way visitors behave (e.g., increased cross-communication? isolation?) or the way that exhibits are designed?

- What aspects of security and privacy do visitors care about most when it comes to data collection? Do we even need to know their names?
- How much, realistically, can visitors contribute to content? Learning how to input is not easy.
- What impact will this have regarding usefulness to the museum in terms of brand extension?
- How do audience demographics affect audience experience with this equipment (including age, gender, physical abilities)?
- What impact do real-world trends have on these efforts – specifically increasing use of portable devices, particularly among teenagers? To what degree does the technological sophistication of the visitor affect the visitor's experience?
- What is the difference in experience/outcomes between a walk-in visitor with his or her own handheld and a visitor who received an orientation using special programs? What is the difference between walk-in versus repeat visitors?
- How do different classes of users (students, teachers, walk-ins, etc.) use this in different ways, including both pre- and post-?
- Which delivery mode works best: audio, text, video, various combinations?
- How does the museum environment affect choices regarding content delivery?
- What is known about scalability questions? Explicit scalability tests are required prior to roll-out.

Concerns

- There are visitor privacy and ethical issues regarding data collection. What data should you collect and is it ethical?





II. INTRODUCTION

A. Forum Introduction & Goals

Rob Semper, Executive Associate Director, Exploratorium

I am the Executive Associate Director of the Exploratorium and am also the head of the Center for Media and Communication, which houses the Electronic Guidebook Project, the program sponsoring this workshop. My role is to push and prod the discussion along with assistance from other staff members and I am hoping that we will have an excellent two days of discussion. I would like to begin by thanking you all for coming.

Background

I want to talk a bit about the project that got this started, why this meeting is happening, and our excitement about planning this session. In 1999 the Exploratorium submitted a proposal to the National Science Foundation for an "Electronic Guidebook" research project. The NSF division funding this project, Informal Science Education, doesn't normally fund research. They provide money for things like exhibits, NOVA, and IMAX, and this is one of the first research projects they have funded. We didn't promise implementation as part of this project. We said it would be a research testbed to investigate the use of handheld computers and wireless networks to enhance the learning experience in a science museum setting.

The project involves technology testing, usability testing, and interface testing, and is being conducted with the help of two partners. The Concord Consortium helped to develop the initial research prototypes and approach and to explore the particular issue of real-time data collection. Subsequently we established a relationship with Hewlett-Packard Research Labs to develop the current testbed infrastructure and to push forward on technology testing, usability testing, and interface testing.

In the midst of the testing and development we have seen two generations of Windows CE and development of 802.11 wireless network from the lab to something you can buy at Costco. We continue to engage in experimentation and research.

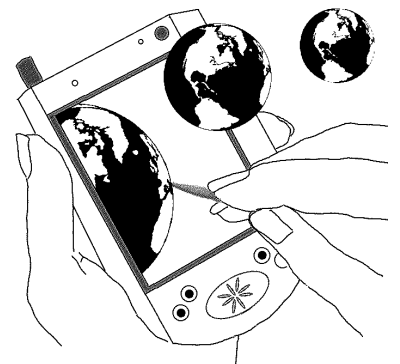
Networking and Documentation

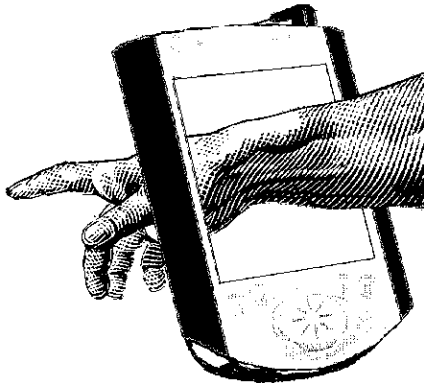
An important part of this project is dissemination. We are not only a testbed, we want to engage other museums in the question of how these tools can be used in these complex, messy settings. We had the idea of holding an invited conference for participants from all walks of life: museums who are already doing projects of this type as well as those who are just starting to think about it; academic researchers; and industry representatives, to address issues of how this can be used in the real world. We wanted to bring these different groups together to talk about where we are globally in thinking about the issues with which our project is involved.

We decided to create a significant documentation of the conference for those in the museum field, in industry, and in academic research interested in the use of

Thanks to Forum Organizers

I would also like to thank Natalie Rusk, Mirjana Spasojevic and her Hewlett-Packard team, Doug Conaway, Jessie Gauld, and the other Exploratorium staff members who helped to organize this forum.





computers in a more fluid, ubiquitous way. By involving a mixture of exhibit developers, educational technology researchers, and commercial developers in focused discussions we hope to explore questions of electronically networked augmented space in a way that stimulates future research and implementation.

We want to take various strands – what is working now, what questions do we have, what have we learned, what are promising directions, what are not so promising – and through documentation, help others move on whether they are implementation projects or research projects.

Forum Goals and Process

So this is a conference to stimulate discussion, to help develop a road map of what the future direction could be. We don't expect to emerge with the road map itself. We do expect disagreement, but we hope to at least establish pointers.

For those of you at this session engaged in your own endeavors, these discussions may help you in your own projects, so it is appropriate to be selfish. The hope is that your selfishness stems from a strong connection to the work being done which in turn will contribute to the depth of these discussions.

This forum is not like a museum conference, it is not exactly an academic research conference, it's not companies getting together to work on industrial strategies, but nor is it blue sky. We have invited representatives from museums, universities, and industry, to create an eclectic gathering and we would like you to take advantage of that mix. Don't sit with your colleagues, sit with someone new. We hope the dialogue between these different groups will improve the overall discussion at large.

We will begin with individual introductions that relate your personal interests in this field. Then to seed the ground we will hear presentations from six projects that have actual, physical experience in different museums and locations. Afterwards we will have a chance to play with the devices being used in these various settings.

Then we spend time on some key questions, discussing what is working, what is not, and what we would like to know more about, and see if we can collect or organize these ideas into six categories. The idea is to focus the discussion into domains. On day two we will continue discussion, and break into smaller work groups to explore some of these issues in depth.

The tone of the meeting is meant to be informal. Feel free to talk, argue, question, support each other. We are not too concerned with protocol. My role, and that of other staff members, will be to try to guide the discussion, ask probing questions, and keep the focus, but not steer the discussions in any particular direction. The point is to get out on the table issues we need to address as a group and I would like you to think of this as one giant collegial group.

3 Key Questions

- Which aspects of using handheld computers in museums do you find most promising?
- Which aspects concern you the most?
- What unanswered questions do you have about using technology in museums?

6 Organizing Categories

- Audience and goals
- Technology infrastructure
- User interface
- Content Development
- Staffing and operational issues
- Research and evaluation (visitors studies)

B. Individual Introductions/Interests

Mirjana Spasojevic, Project Manager, CoolTown Program, Hewlett-Packard Research Laboratories

As a conspirator on the project I would also like to welcome you all here. I am from Hewlett-Packard Labs, a central research organization for Hewlett-Packard. We are not part of marketing or divisions, we get to do the fun part _ looking at technology, making prototypes, studying various scenarios, which we then eventually transfer to product divisions.

This project, the Electronic Guidebook, is pushing the typical behavior at Hewlett-Packard Labs which is a set of demonstrations in a room. This time we thought : What if we go out and try it out on a lot of people? This collaboration has presented a unique opportunity to work with people who are not like ourselves, and to interact with real museum visitors.

Andrea Bandelli, Museum Consultant

I am from the Netherlands and am an independent consultant. Recently I have been working on a digital program on Life Science that involves eight major science museums in Europe, and I have been assisting a new science center in Torino, Italy forge stronger links with industry and research labs.

I'm here because I'm interested in new technology and because I work with so many individuals and museums in Europe that it is easy to create new programs. So I'm serving as a sort of ambassador. Previously I worked on an Amsterdam science center project to inform staff about what is happening on the floor. The attempt was to get as much information as possible from visitors.

One form of technology with high potential is cell phones. In Europe they are crazy about cell phones. Sixty to seventy percent of people in Europe have cellular phones. It's an easy way to exchange information and it's a technology people are confident with. Young people already exchange more text messages than audio messages. So I'm interested in the role of mobile devices as part of a project that is working on the role of visitors as curators at a museum in Frankfurt.

Tom Steller, Chief Curator, Natural Sciences, Oakland Museum

I head up the science department at the Oakland Museum. The museum has been looking at reinstallation of all three major galleries. In the science gallery we have a traditional presentation in a number of ways. We are looking at ways to change the visitor experience so that they have interaction with the content there, content that is now not accessible. We are looking at handheld devices and other assists as a component of this so it is timely to explore what is out there.

Rakhi Rajani, Researcher, Hewlett-Packard Research Laboratories

I am from the United Kingdom and am currently an intern at Hewlett-Packard Labs, looking at the usability issues of handheld devices.

Introduction Guidelines

The idea is to have everyone introduce themselves and as part of that introduction briefly describe their interest in the topic, whether that involves a project you are doing, one you are thinking about doing, or whatever your interest might be. • Rob Semper, Executive Associate Director, Exploratorium

Melissa Alexander, Project Director, Origins, Exploratorium

At the Exploratorium I'm involved in an effort to bring people behind the scenes to observatories and laboratories around the world to look over the shoulders of scientists. My interest in technology is the opportunity to give visitors greater depth and to alter information and experience for themselves. I see it as a tool to move beyond the museum out to the world.

Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

I have spent the last couple of months working on the content of the Electronic Guidebook project.

Kathleen McLean, Director, Center for Public Exhibition, Exploratorium

I'm Rob Semper's colleague and am very interested in appropriate use of this technology. I have been working with Tom Steller of the Oakland Museum, and have been urging them to go forward on handheld devices. I'm interested in the usefulness of these devices and my guess is that they present a wonderful new opportunity which has less to do with access than it does with contemplative and observational experiences. I wonder about highly interactive experiences and how these compete.

Doug Conaway, Resource Development Director, Center for Media Communication, Exploratorium

I'm involved in fund raising, strategic thinking, and development, and want to glean ideas for future research and programs. I also work on external relations with various entities so I'm pleased that this forum involves entities from outside the museum world. I'm interested in exploring how the museum can play a broader role.

John Turner, Learning Studio Facilities Coordinator, Exploratorium

I'm new to the Exploratorium but not to experiments in technology. This is the first job where people are researching how handheld devices can be used.

Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota

I work with kids and adults and technology. I have been interested in how handheld computers are like Legos – you can create inventions. I'm more interested now in adult devices, but I am really skeptical. My background is in art. I'm not sure these can be put to good use in an art museum.

Margaret Pezalla-Granlund, Museum Consultant

I am a consultant and also work as a museum educator at the Los Angeles County Museum of Art. My background is in art, but I work as much in science museums. I'm interested in the use of handhelds in messy environments like the Exploratorium, but also in art museums.

Kristina Hooper Woolsey, Consultant

Rob Semper and I have been talking about connections between real space and virtual space for the past twenty years and I am interested how handhelds can enhance that. I have been with Apple for fifteen years, working with multimedia and human interface. Now I'm on the other side, working as a consultant for the Irvine Foundation on an initiative involving communities organizing resources to enhance learning for underserved youth. It is a collaboration involving a range of cities, exploring how to provide for kids learning through educational opportunities in the community, outside of traditional schools. I suspect with handheld devices and other opportunities (I'm interested in acoustical signals) it is possible to design something completely new.

Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

We will be presenting information later today about the Points of Departure exhibit at the San Francisco Museum of Modern Art. We are in the process of evaluating how that works. I'm looking forward to hearing about other future museum and Web projects and other I'm looking forward to future SF MOMA work in that area. On the logistics side what is exciting about this for us is getting movies into galleries –not just off to the side, which is the typical model, but right there with the art.

Genevieve Biggs, Public Information Officer, Moore Foundation

I'm here as an observer for the Moore Foundation. Gordon Moore, the founder of Intel, is a fan of the Exploratorium. My role involves external and internal communication for the foundation, and I'll be reporting back on this forum to the foundation. I'm excited to hear what you are all doing.

Daniel Molitor, Consultant

I am an independent consultant and was one of the original team from Walt Disney Imagineering working on designing exhibits for Port Discovery children's museum. I also work on the Kid Club at Port Discovery and will be talking more about that later, and addressing issues of how handheld devices can be used to encourage physical interaction with exhibits.

**Jenna Burrell, Application Concept Developer,
Intel Architecture Laboratories**

I'm here as a stand-in for Richard Beckwith, and I've been with Intel for four months. Before that I was at Cornell working on context aware computing which has obvious implications for a museum environment. I'm now with a group doing ethnographic research on museums and people.

Rachel Hellenga, Director of Exhibits, The Tech Museum of Innovation

We are launching a couple of different projects. One, dealing with the issue of sustainability, is the smart museum initiative. As things in science and technology are changing fast we want more updatibility of components. I'm involved in developing something called smart museum bracelets. My colleagues call it the "magic bracelet." Why a bracelet? We wanted disposability and cheapness but at the same time we wanted something highly interactive that wouldn't occupy the hands.

Michael Drennan, Technology Developer, The Tech Museum of Innovation

I'm involved in hardware and software design and am interested in new technology and ideas we might use in the smart museum realm – specifically, wireless technology and what visitor experiences with that technology would warrant our time in developing it and their time in using it.

**Craig Rosa, Director of Information Technology,
The Tech Museum of Innovation**

Part of my role is overseeing the Web site and I continue to be interested in development in that area. Today my interest is in handheld devices and wireless technology and the Web site – and how those three can be developing in parallel in a way that really makes them work. Regarding my feelings for wireless technology, someone earlier expressed valid skepticism. I'm at the other end of the spectrum. I'm interested in content and how to make it work. I'm interested in where wireless fits in the spectrum of the learning continuum, in the effort to develop and provide good content, in the holy grail of establishing a relationship with visitors.

**Judith Kirk, Assistant Director, Mathers Museum of World Cultures,
Indiana University**

We are a museum of anthropology and we are a small size museum. We have been involved in a project called MUSEpad, which I will be talking about later, involving mobile computing for people with disabilities. I've always been interested in reaching different audiences and in human-computer interface, and have entered graduate school for further study in administration of assistance technology. During the MUSEpad presentation I will also be talking about how we collaborated with an information development company.

Stephen Bannasch, Director of Technology, Concord Consortium

I will be presenting later today and have brought a lot of toys for exploring the world through probes and sensors. We have been working since 1995 with handheld devices through the SLiC, Science Learning in Context project. My

**Larry Shaw, Senior Media
Specialist, Exploratorium**

I'm with the Center for Media Communications which offers support for communication projects including this handheld project. I'd like to kibitz, to use the consciousness here to talk about engaging people in an ongoing way in a broader sense.

**Katherina Audley, Content
Developer, Electronic
Guidebook Project,
Exploratorium**

I've been developing content, videos, JPEGs, and so forth for the Electronic Guidebook project and throwing them into the device. Now we're looking at what is working and what isn't. I'm curious about what others are doing before dumping a tremendous load into their own gadgets. I also do visitor research and evaluation, watching visitors interact with exhibits, and I also work on Webcasting, so I'm in a lot of different places in the museum.

Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

I'm working on the Electronic Guidebook Project. When I came to the project I hadn't paid much attention to handheld computing though I had worked with computers. I heard a term that I think is useful in describing my relationship to this: "skeptical friend." Part of why I became involved in this project is because I heard that it involved a group of people from a variety of museums coming together for this discussion.

Susan Schwartzberg, Senior Artist, Exploratorium

I have a different involvement with technology. I'm interested in the expressive potential, whether getting information or creating information.

When the World Trade Center happened, there was the role that all those phones and pagers played during the event. I think it is something profound that happened but it's not talked about.

I'm also working on a project, The Mind & Learning grant, about consciousness and the mind and how we think. I'm hoping these devices can help us collect those thoughts and serve as "epiphany gatherers."

interest is in looking at the world and how that can be represented on a computer and the interaction involved. Handheld devices are of interest to us at the Concord Consortium because they allow portability – you don't want to constrain kids to a lab table. They also allow representation of data you have collected.

Since 1995 we have been a member of CILT, the Center for Innovative Learning Technologies, and we are responsible for the Ubiquitous Computing theme in CILT. We have several projects now that involve using handheld devices including: the Exploratorium Electronic Guidebook project; Probeserver and the Data and Models thermal conductivity system; TEEMSS and CC Probeware; and Modeling Across the Curriculum.

Jim Thornton, Member of Research Staff, Xerox PARC

My background is in systems software, working behind the scenes, so this is new to me. I'm interested in the issues concerning what goes in – content development.

Allison Woodruff, Member of Research Staff, Xerox PARC

I'm also from Xerox PARC, an industrial research lab in the South Bay. I've been thinking lately about electronic guidebooks as they relate to historic houses and visitors studies. For example, does a shiny object in your hand distract you?

Paul Aoki, Member of Research Staff, Xerox PARC

I have a background in systems software which, as Jim says, is behind the scenes. Xerox PARC has a long history in the area of ubiquitous computing and human-computer interaction. For me, studying the use of technology in a historic house is an opportunity to learn about these methods. Museums and historic houses are interesting settings because we want the technology to disappear – not physically, but in terms of people's attention.

Tim Kindberg, Scientist/Engineer, Hewlett-Packard Research Laboratories

I am a systems software person. There's a fascinating side to ubiquitous pervasive computing. We have lots of devices on us, and the world has lots of devices in it. I work on what bits of software go onto this or that. I'm also interested in evaluation, and was involved in an ethnographic study on caring for diabetic patients. I am also a sceptic and what counts as evidence as criteria of effectiveness. What is going to count?

Eamonn O'Brien Strain, Research Scientist, Hewlett-Packard Research Laboratories

I also have a technology infrastructure background, in particular working on the infrastructure to support social communication and streaming media. I'm impressed by the power of today's PDA's. They can fit on your watch, they're always on, twenty-four hours a day. What are the implications of that? What technology makes sense?

Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston

I'm intrigued by the quality. You have a cyber animal tracker built for Kalahari bushmen and now kids in a museum use handheld devices. We have a large scale activity center at our museum. I'm fascinated in how kids learn about models, create models, and use models. I'm interested in what the Concord Consortium is doing. We're in the initial phases, looking at what probeware might look like.

Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories

In the misty past I was involved in social sciences and did actually work in a museum. My present interest lies in how to use handheld devices in a variety of situations. For example, the home environment: what could they do for you in our home without being irritating. I also work on interfaces that might involve speech.

Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago

I'm here just to put a toe in the water. My task is to get the lay of the land and learn about different options and what is of value for different activities. So for me this is an embarrassment of riches. I'm listening from the operations side, the visitor side, and the financial side, to learn about opportunities for museums.

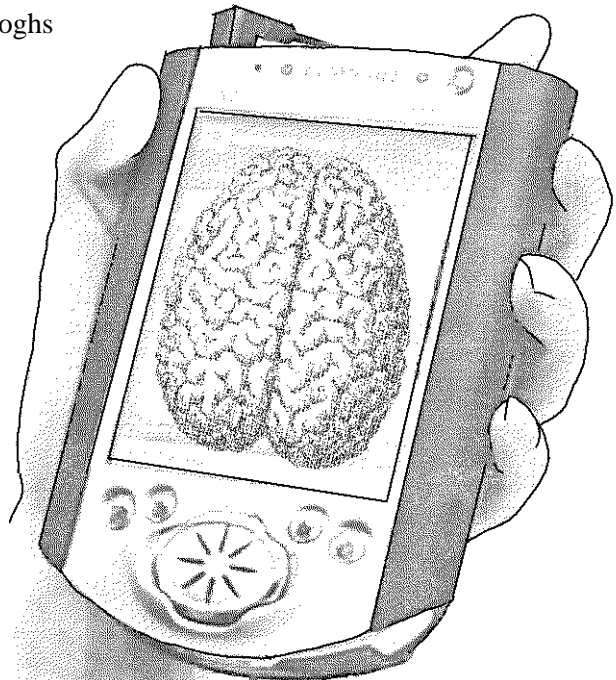
Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

I've been working on a lot of the technology that you'll see used in the Electronic Guidebook Project. I joined Hewlett-Packard several years ago working on small embedded Web servers, which grew into more sophisticated technology. We saw the need for a level above it of services which we call CoolTown. We hung two Van Goghs on the wall so now we have a little museum.

I am mostly involved in getting things to work, and in figuring out how to tweak technology that has already been developed in the challenging environment here at the Exploratorium.

Rob Semper, Executive Associate Director, Exploratorium

I have a couple of thoughts after hearing your introductions. It's wonderful to hear about people's backgrounds, and I'm struck by how this has realized a dream of mine. It's like a dinner party to which you invite a mixed group and the whole goal for this session was to create a crossover, a mix. I think that has happened and now we can bring this to fruition in the next day and a half.





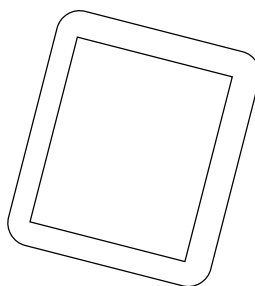
III. SAMPLE PROJECTS

A. Points of Departure - San Francisco Museum of Modern Art

- Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art
- Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

Curators and Educators Collaborate to Prototype a "Museum of the Future"

This show involves works we knew to be confusing or disturbing to our viewers. We are trying to combine those works with different uses of technology in our gallery space, including iPAQ Gallery Explorers and Smart Tables, to see what would work with our viewers.



Presentation included images of the installation at the museum, works of art on view, smart tables, and visitors using iPAQ Gallery Explorers.

The Brief:

Select great works from our permanent collection that many visitors consider difficult . . . Then try to innovate with the visitor experience in mind.

Four pilot approaches:

- Smart Tables
- iPAQ Gallery Explorers
- Make Your Own Gallery
- Making Sense of Modern Art

One Smart Table in each gallery.

Artists' video clips were presented on the iPAQs, each two to three minutes long. There were two to three per gallery for a total of 17 clips.

The Technology

We were operating under tremendous time constraints and limited resources. We originally thought about working with some really experimental technology at MIT Media Lab that involved technology attached to a pair of glasses that would recognize what you were looking at and show the visitor a video clip. It turned out not to be ready for primetime.

We were developing content and thought we should get the videos out somehow so we ended

- Compaq iPAQ Pocket PCs with video clips stored on 64 MB Compact Flash cards
- Internet Explorer and Windows Media Player running on Windows CE (imperfect)

Sample Projects Overview

The goal here is to seed the ground. These six demonstrations will help us look at the lay of the land and will give us something to talk about concretely when we get to the discussion points. • Rob Semper, Executive Associate Director, Exploratorium

Web Site

<http://www.sfmoma.org>

Points of Departure: Connecting With Contemporary Art

On view at the San Francisco Museum of Modern Art March 23, 2001 - October 28, 2001

This exhibition has been conceived as an exploration of new ways to present the collection and to support it educationally through innovative technologies. Rather than grouping art chronologically, biographically, geographically, or by the movements through which art history is often described, the works on view here are presented thematically.

Each of the six groupings, or "points of departure," emphasizes a particular artistic approach or formal question that has emerged from our own observations of the choices artists make, as well as from questions visitors often have about contemporary art. - From SFMOMA Web site: http://www.sfmoma.org/exhibitions/exhib_detail/01_points_of_departure.html

Other Exhibit Components

Making active use of new technologies and multimedia education programs, this exhibition includes touch-screen "Smart Tables," featuring introductions to the exhibition's themes and video clips of artists and curators discussing the work.

Kiosks placed near the "Found, Recycled,

Repurposed" and "Style" sections offer Making Sense of Modern Art – the

Museum's multimedia program, with new content developed especially for

Points of Departure – and Make Your Own Gallery,

which invites visitors to organize their own exhibitions. The artworks themselves, the six curatorial

themes, and the educational programs are all seen as "points of departure" for

each visitor's open-ended process of looking, learning, and appreciation.

- From SFMOMA Web site



up using off-the shelf technology. The devices were lent (and have now been given) by Compaq. We used a PCMC flash converter and the movies are stored on a flash card which has worked pretty well.

- Basic interface organized by the titles of the galleries.

The interface is really straightforward, based on a list of galleries in the exhibition.

Visitor Use

An attendant is always on hand. There is a need for an attendant to give instructions because of one major bug with the interface – the result of not having enough time or resources. We didn't do custom programming and there are lots of ways for the user to get out of our path. We can instruct them, but they can still get way out of the proposed path. It's not seamless and durable.

- All visitors over the age of 12.
- Asked to leave ID and credit card.

So the attendant explains how to use the device and if there are problems the visitor can go back to the attendant. We ended up having the attendant copy the settings back onto the unit each time a unit is returned in case the visitor has changed it.

Content

In terms of content, what is most successful is the artist talking about a work that is right there for the visitor to see. An artist talking generally about his or her work is not as successful. The content is also redundant – the same video clips are on the Smart Tables in each gallery.

Evaluation

The evaluator was interested in knowing how the experience differed for those who had used PDAs before versus those who hadn't. It's interesting that their experiences weren't all that different. A whopping 83% of all users said that the iPAQ had enhanced their experience.

Early study by JFK graduate student Mandy Smith, focused on usability and comparing PDA users with non-users.

- 50% of users had no PDA experience
- Of those 68% rated ease of use at 8, 9, or 10 (with 10 as high)
- Of all users 69% rated ease of use at 8, 9, or 10 (with 10 as high)

54% of those surveyed said they would want "more" information. We're investigating what that means now . . .

As part of the evaluation process we have been selecting visitors randomly, then interviewing and tape recording. The first component below asks visitors to

evaluate all components in the exhibit, not specifically the iPAQ, so in addition we want to specifically ask about the iPAQ.

Additional evaluation in progress

20-minute interviews with general visitors to understand how they experienced the exhibition

10-minute interviews with iPAQ users to further probe the question of how to provide "more" content and to understand how visitors became interested in the device in the first place.

This is a different organization that the museum usually has so we are also evaluating that. We're looking forward to the reinstallation of the permanent collection and the use of handhelds with that.

Lessons Learned

What did we learn?

- People love to hear and SEE the artist while looking at the artwork
- Visitors expected a tour
- Interface had too many holes
- "iPAQ Gallery Explorer" was confusing

What would we do differently?

- Customize interface
- Focus content on works in gallery
- Add strap!!

Visitors really liked the artists talking about their work.

Visitors were expecting something like an audio tour with a narrative thread. It's not like that – there are no connectors.

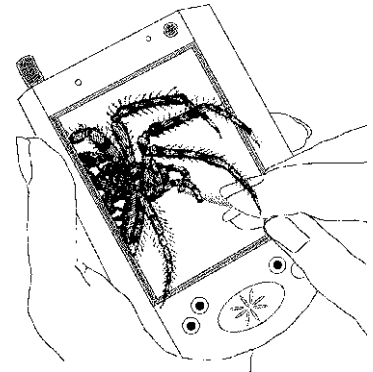
There was a definite problem with the interface. We need to work on customizing that and we need to work on content focusing on works in the gallery.

In response to the question of why we didn't use wireless technology, it was because of timing and resources. And because we could run everything locally, we did it that way.

Questions, Comments From Forum Participants

Isolation/Alienation

- I went two days ago with a friend and found it [use of the iPAQ] a solitary experience. It was nicer at the Smart Table with a friend. • Andrea Bandelli, Museum Consultant
- Response: A lot of people have said that, that it can be alienating. It cuts down on the social aspect. We have found people like to gather in groups of two or three at the Smart Tables.



"... a similarity between a spider and my mother."

Artists in Action

- One of the video clips available on the iPAQ was shown. Louise Bourgeois, referring to a spiderlike sculpture she created (*The Nest*, 1994), realizes it reminds her of her mother.
- Reference is made to a Raschenberg video clip that allows you to see a work on the opposite side of the drawing on view in the gallery.

Initial Visitor Responses:

"It made me appreciate it more. A lot of what I saw in there, I didn't really think about how it was made until I was watching him and seeing the techniques he used. It did add another level of understanding to it . . . At first, I just kind of walked around quickly and looked, you know? But then when I took a closer look, and watched him actually creating, it changed my – my perceptions of it, definitely. And I want to go look at it again."

"We stayed in front of the art a lot longer than we ever do when we come normally. And we've seen, I think, almost all of these pieces before someplace in the museum. And yet, we hung around them longer because we were listening to what the artist had to say about what was going into his or her thought process; and that was fun."

Involved in the Xerox PARC Sotto Voce project but not present at this forum:

- Beki Grinter
- Amy Hurst
- Peggy Szymanski

What's in a Name?

We didn't actually have a name for this project when we were invited to this forum. We're now calling it "Sotto Voce," which means comments made in a confidential manner.

Web Site

For more information visit <http://www.parc.xerox.com/guidebooks/>

The Setting

Sotto Voce has been tested in several rooms at Filoli, a historic house in Woodside, California. <http://www.filoli.org/>

The Equipment

- Compaq iPAQ
- Single-ear headset
- Lucent wireless card



B. Sotto Voce - Xerox PARC

- Allison Woodruff, Member of Research Staff, Xerox PARC [Presenting]
- Paul Aoki, Member of Research Staff, Xerox PARC
- Jim Thornton, Member of Research Staff, Xerox PARC

Our Motivation

At Xerox PARC we have spent a lot of time studying electronic guidebooks and how visitors use them in practice. I'd like to start by telling you a little about our motivation. This is one of the prototypes we're working on and experimenting with. Guidebooks are good at presenting information, at conveying content, at enabling interaction with an exhibit, and they're also social. So our job is to look at how guidebooks can be used for exhibits and for social interaction.

Visitors want . . .

- information
- an immersive experience
- social interaction

Goals

- Increase engagement with environment
- Facilitate interaction between companions

Prototype

Visual Interface

- Tap on objects in pictures to get descriptions - If miss, outlines appear
- Press button to change viewing perspective

Transient tap tips indicate imagemap targets as needed. With tap tips, an outline appears around targets if you miss a target. We don't want to drive visitors, we want them to look around and become engaged. Our hope is that this is a usable interface that helps visitors maintain visual flow. It doesn't require a lot of attention to operate.

If visitors are wearing headphones they're separated from their companions, so we have provided the opportunity to eavesdrop on the audio content of a companion's guidebook. The fact that visitors can work independently but also share information helps with social interaction.

Eavesdropping

- Ability to eavesdrop on companion's guidebook
- Single-ear headset
- Supports both sharing and independent activity

Eavesdrop

- Off
- Quiet
- Loud

Room

- Library
- Hallway
- Study

Experimental Method

Method: A Visit to Filoli

- Paper guidebook use
 - Audio-taped
- Electronic guidebook use
 - Video- and audio-taped
 - Logged guidebook actions
- Semi-structured interview

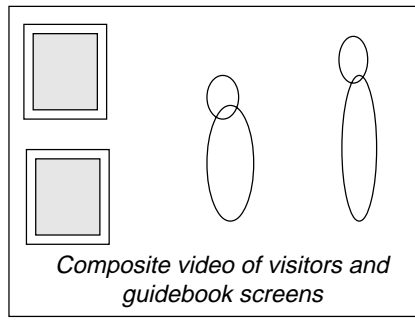
During the first part of the visit there is a paper guidebook. We audiotape that use so we have something for comparison.

Then during the electronic guidebook use we video- and audiotape them, and finally we interview them about their experience.

There are a variety of ways to analyze the data. The sociological method involves looking for organized patterns of behavior; a very detailed method. We take a video of the visitor and their guidebook screen and see what systematic practices we are able to observe.

Method: Analysis

- Affinity clustering
- Conversation analysis
 - Examine social interaction to reveal organized patterns



Findings

- Positive visitor response
 - "Fun," social experience, easy to use
- Visitors balance attention
 - Avoid "audio tour bubble"
- Sotto Voce supports different kinds of interaction
- Many visitors assign Sotto Voce a role in their conversation
 - Give guidebook turns in conversation
 - Allow guidebook to introduce topics of conversation
 - Treat guidebook like a human storyteller and share responses to stories

We have come up with a number of findings, and you can visit our web site for more information on these. There is a nice balance between visitors' attention to the guidebook, the room, and their companions. We observed different kinds of visitor interactions. Some visitors don't want to talk to each other and we seem to support that just fine. Some interact with their companions a lot, and that also works with the guidebook. So this works with a range of different visitors; we find it follows their natural inclination.

The Guidebook as a Conversationalist

We found that the guidebook also plays a role in conversation. Visitors gave the guidebook turns in the conversation, they let it interrupt them, and they interacted with it much as they would with a human storyteller.

A Video Tape of Visitors Using Guidebooks at Filoli

Notice that visitors are not spending a lot of time listening to descriptions, how they are looking around the room, interacting with each other. They're not spending too much time with the interface, figuring out how to use it.



Content

- In terms of content, is it one object to one piece of content?
- Response: Yes, and it's currently voice only. It would be interesting to think about relationships and layering.

Questions and Comments From Forum Participants

Changes Room to Room

- How does the unit change as you move from one room to another?
- Response: We have a radio button for that, and we only have this in three rooms. I think a location sensor would be good for that, but since we only have three rooms we haven't bothered.

Orientation Between the Real and the Virtual

- Do visitors tend to get lost between the handheld and the objects in the room?
- Response: They tend to do well. Smaller children have a little more difficulty with spatialization.

Who Becomes Your Companion?

- When people get the iPAQ do they find out then who their companions will be?
- Response: We're working on a more fluid definition of companion and who a companion will be.

Was Development Linear or Interactive?

- Regarding who your audience is and what you are trying to achieve, was development linear or interactive?
- Response: The development was driven by problems identified in the space. I went to Attingham Summer School, a school for museum curators where we talked about problems linked to historic houses. We determined that selecting objects in historic houses poses serious problems so we decided on visual selection. And we tried various ways of delivering information and determined that social interaction was very important so that became a goal.

Comparison With Docent Interaction?

- Does this museum have a docent program, and were any comparisons made about the type of questions asked of docents and use of the guidebook?
- Response: Yes, they have very active docents but the visitors had no opportunity to compare. A lot of visitors say they like this more because they have more control, but there is also a trade-off. If you had an ideal docent, that may be more desirable. That brings up another issue however. The Filoli docents were not very happy about this project. They said, "There's no humanity."

Presentation of Content

- How is the material presented? Is it text on a screen?
- Response: It is presented via audio descriptions which are short, about thirty seconds. It fits well with the flow of conversation. We did an experiment with text which was strongly dispreferred by visitors. With the audio, they're not looking back and forth between the screen and the room. We want them to be able to look while listening and on the part of visitors, audio was extremely preferred.

- So you use still frames on the screen?
- Response: Yes. There are four still frames for each room. People tend to get more confused with a continuous pan. Discrete facings allow people to align themselves, to chunk the data.
- Given the size of the screen, what kind of resolution do you get with the objects?
- Response: The objects are very small, but people are good at recognizing them because of the location and audio description. The smallest object in the room is five or six inches wide and appears on the screen about ten pixels wide.
- How do people select objects on the screen?
- Response: By touching it with a stylus, though you can actually do it with your finger also.

Durability

- How long have you had this in operation, and how is it holding up?
- Response: This is very much a research project. We're not in deployment mode. Given that, the studies are very good. There have been no technical problems at all in the first round, no crashing or anything.

C. Kid Club Communicator - Port Discovery

- Daniel Molitor, Consultant

About Port Discovery

Port Discovery is a children's museum in Baltimore with exhibits designed by Walt Disney Imagineering, which I worked for at that time. It's located in an old fish market in Baltimore. It is a hands-on, skills-oriented museum but it is not about any particular subject. The age range is from toddlers up to eleven- and twelve-year-olds.

- hands-on
- skills-oriented
- somewhat skewed

They didn't want a traditional children's museum so it is weird and strange inside. For example, there is a climbing wall cantilevered out over a balcony about eighteen feet above the ground where kids learn to take chances. There is another exhibit that is like Lucy and Ethel in the chocolate factory, in which children match shapes to gizmos as they move past. As you enter the museum, there is a contraption that sucks doubt out of your brain and you are sprinkled with inspiration.

Problem Solving Through Ancient Egypt

In an adventure exhibit, kids go off to ancient Egypt through a variety of themed environments searching for clues and solving problems. It is not about ancient Egypt; it's about learning to cooperate, problem solve, and communicate. For example, they learn how to make a cartouche with hieroglyphics; there is "Mummy Dearest," where they climb inside a sarcophagus. If they do all of the activities and find all of the clues, they can make a Pharaoh magically appear if they enter the right symbols.

Web Sites

Port Discovery
<http://www.portdiscovery.org/>

Aether Systems
<http://www.aethersystems.com/>



Orientation, Fanny Packs, & Tethers

When visitors get a Communicator we take their name and a credit card. They get a user name (we have filters in place for screen names that aren't appropriate). Then they have to go through an orientation on how to use the Communicator, how to use the scroll wheel, the keyboard, and so forth. We find that is really important because there is a learning curve and it helps if you go through orientation beforehand.

We also have pouches, fanny packs, for the Communicators with a logo and a Kevlar tether (and we did lots of experiments concerning how long that tether should be). We have the world's largest climbing structure at Port Discovery – 48-foot tall, the size of a four-story building – and we didn't want kids to be climbing that holding a Communicator in one hand.

Introducing Handheld Devices

We found that kids were having problems at the last step. You have to find four secret signs to solve the problem, and the kids weren't recording or remembering the clues. We wanted the kids to have a way to record the clues as they went along. In fact, we started developing the activity that way and then completely forgot about it.

We invented the Port Discovery Kid Club. Kids create their own activities and computers allow them to personalize their experience. This is the first time high tech was introduced to Port Discovery. We also want to attempt to bridge the digital divide. In Baltimore there is a clear distinction between the haves and the have-nots, and Port Discovery is one of the few places perceived to care about kids.

Port Discovery Kid Club

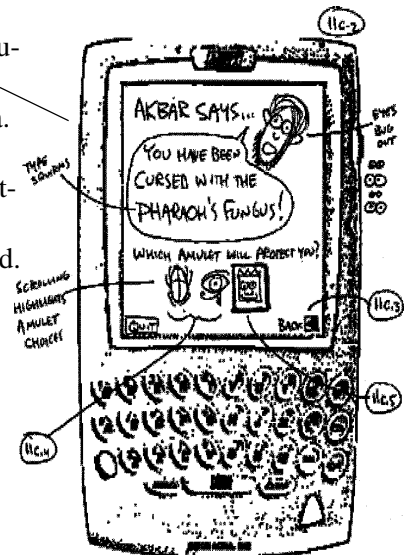
- for kids, by kids
- personalized exploration
- bridging digital divide

RIM Blackberry Pager

- compact
- tough
- long lasting battery
- scroll wheel
- icon-based navigation
- C++ O.S.

We lucked out – Aether Systems, located in Baltimore, decided to donate devices to the museum and air time for one year. So that's the platform of choice. The device is the Blackberry Pager and it's pretty cool – it's always on, it has e-mail, and there is a two-way pager. We did have some doubts. The graphics are one step above a digital watch; it's small, and there are not a lot of custom applications so we had to do it all ourselves.

We came up with the name "Kid Club Communicator." The applications had to be custom designed and we treated them like multimedia. There are eighteen screens in the orientation activity (with nearly 300 screens in the exhibit-enhancing activities) and it is self-guided, all multiple choice. We plotted it like a storyboard.



Kid Club Communicator (KC 2) a.k.a. RIM Blackberry Pager



Hardware:

Intel 386 processor, built-in wireless modem, keyboard for text entry, scroll wheel for icon-based navigation, backlit monochrome LCD screen

Software:

- Custom software (C++) running RIM o.s. environment
- Web-based PC log-in procedure
- Wireless communication (instant messaging) between individuals and groups
- Interactive experiences linked with physical exhibit activities

Cost:

\$200-\$300/unit + monthly wireless network subscription fees (\$40/month)

Exploring Ancient Egypt With a Kid Club Communicator

We wanted the kids really interacting with the experiences in the exhibit, not just focusing on the device. There is lots of back and forth between the exhibits, handheld activities, multiple choice questions, and so forth. For example, in a village setting they make amulets against the evil eye. In another they identify scents in a spice cellar and do a quiz on the handheld device which rewards you with a pay off (like fluffy bells on the device itself).

There is an “I spy” game prompted by the device in which the kids identify a constellation above a pyramid. In another area there’s a hieroglyphic decoder wheel. The handheld gives you a bit of text and you use the physical device in the exhibit to decode the text.

In another section there is a little tomb maze. At one point you reach a shrine and if you have a handheld device you have to find one of four Egyptian gods. If you pick the hieroglyphic symbols above the god’s head and enter it into the handheld, it triggers a video in the exhibit. The only way to get the video is if you are using the handheld device. If you do it physically without the handheld device, it triggers a different video, one that isn’t as cool.

We also use the devices to move people between spaces. We have travel beacons with LED displays with space-time coordinates. When the kids have done all of the activities in one space they are prompted to go to the next beacon. You enter the space-time coordinates in our handheld and it opens up activities in the new area.

Kids earn points as they complete activities successfully. They like this system, they’re familiar with it, and they like a way to measure their achievement. If you get 100 points you earn the right to use instant messaging with others in your group (with a group size of thirty). A custom application allows you to communicate one-on-one or with the whole group. We set up some activities that require them to talk between spaces or rooms in order to figure out the activity.

So even though we’re stuck with a problematic device, it ended up being pretty cool. The devices have been in use about five months and they have survived a number of unplanned drop tests.

In terms of problems, an obvious one is airtime cost but the same thing could be done with a local network.

Questions and Comments From Forum Participants

Air Time and Custom Programming

- When the free air time from Aether is up, what then? Will you be switching to a new set up?
- Response: I would certainly hope so. One problem was having to do everything custom with C++ programming, and we had to hire outsiders because none of us are programmers.

Serendipitous Games and Socialization

The instant message function and ability to communicate with each other has been popular. The kids came up with their own games such as a scavenger hunt, their own I-spy games, twenty-questions type activities. It generates discovery among kids, and you have socialization as a result.



Crash-Proof Software and Hardware

- How good were the kids at crashing the system?
- Response: It’s pretty tough to crash it. It’s hard-wired so there’s no way out. This is the only application running on the device.
- Were you worried about the robustness of the device?
- Response: Yes. They’re thrown, flung, dropped.

Web Sites

“Accessibility and New Technology in the Museum,” Judith Kirk
<http://www.archimuse.com/mw2001/papers/kirk/kirk.html>

Mathers Museum of World Cultures
<http://www.indiana.edu/~mathers/new/index.html>

WorldBoard Project
<http://www.worldboard.org>

Information in Place, Inc.
<http://www.informaiton.inplace.com>

D. MUSEpad - Mathers Museum of World Cultures

• Judith Kirk, Assistant Director, Mathers Museum of World Cultures, Indiana University

Providing Universal Museum Access

I will be talking about the following topics during this presentation.

- WorldBoard
- NIH Feasibility Study
- MUSEpad
- Future Development/ Phase II

WorldBoard

The WorldBoard is an extension of the Web that associates Web pages with location information via GPS, infrared, and things of that nature. Worldboard utilizes wireless connectivity and positioning systems to enable visitors to access Web-based information correlated with physical locations or objects. The WorldBoard represents a convergence of technologies.

- ### Converging Technologies and WorldBoard
- The Web
 - Mobile/Handheld computing
 - Wireless networking
 - Positioning systems

WorldBoard

Take the Web off the desktop and place it in environment
Associate Web pages and/or other digital objects with a location or context

WorldBoard was conceived at Apple Computer and developed at Indiana University. When we started looking for applications, some went private, such as Information in Place, Incorporated.

NIH Feasibility Study

Small Business Innovative Research Grant
Low-vision, low-hearing, mobility-impaired
Six-month project timeline
Research Partners
Information in Place, Inc.
Mathers Museum, Indiana University
Institute on Disability and Community
Evergreen Institute on Elder Environments
School of Health, Physical Education, and Recreation, Indiana University

NIH Feasibility Study

Both Mathers Museum and Information in Place, Inc. became part of a partnership to undertake an NIH feasibility study to determine whether a mobile computing tool called the MUSEpad that uses emerging WorldBoard technology could serve as a useful device for people with disabilities. We wanted to explore this because we were interested in customization of content for different users.

Goals

- Create user profiles
- Gather content and develop “channels”
- Investigate authoring kits and templates
- Undertake proof of content testing

To create user profiles we had to look at individual needs. We worked with people with low vision, with low hearing, and with mobility problems. Content involved exhibit spaces from A to Z, while channels were different modes of developing content including audio, video, etc. We also investigated authoring kits and tried to figure out templates to take this into other museum settings.

We wanted a device that wouldn't just address low-vision, but a wide range of low-vision problems. When we talked to consultants they told us we needed to address a range of low-vision problems. And when we talked to those involved with assistive devices we learned that there is always some customization or personalization of assistive devices to meet the needs of individual users.

Our audience studies first involved those with low-vision, low-hearing, and mobility problems, then a group of regular visitors. We made observations concerning how they moved through exhibits, how they interacted with each other, and then we conducted surveys. Next came focus groups which were cross-representational, comprised of participants with all different disabilities and with no discernible disabilities.

We had a major problem with the hardware we wanted to use. We were talking about using Compaq iPAQs, but the groups we talked to wanted larger screens. As a result we went with the Casio FIVA, but it weighs 2.3 pounds. We ended up using a neck strap and people didn't complain about the weight, but this was in a small exhibit area so they didn't have to carry it around for any great length of time. People were given a two-minute orientation and then did whatever they wanted.

We discovered that audio was by far the overwhelming choice. Of course people with low hearing don't normally prefer that option but they do if it can be linked directly to their hearing devices. Audio includes description – describing artifacts for those with low vision.

In terms of video, that might involve video clips of a craftsman working at their craft, or a Quicktime VR involving a 360-degree rotation around an object, which was a popular feature.

There was a major debate with audience and team members about audio updating versus manual control. We soon realized that our particular participants preferred manual control and the ability to call up information when it was wanted rather than having it automatically delivered. For example, we discovered that people didn't necessarily want information when they were standing near a beacon but might want information about an object across the room.

People also wanted a way to have bookmarks. We didn't have time to incorporate that, but it was a major request from participants.

Regarding wheelchair mounts, people have different kinds of wheelchairs so we had to go back and ask them how they could use handhelds.

And people wanted custom "skins." Some wanted to jazz the device up, others preferred something more conservative.

NIH Feasibility Study - Process

- Consultants and literature review
- Assistive technology
- Museum visitor studies
- Universal design issues (CAST)

- Audience studies
- Observations
- Surveys
- Focus Groups

- Paper prototype/participatory design

- Design mock-ups

- Proof of concept testing
- Off the shelf components
- Audience studies
- Observations
- Surveys
- Focus Groups

NIH Feasibility Study Results - Features and Functionality

- Audio
- Narration (Text to Speech)
- Description
- "Samples"

- Video
- Clips
- QuicktimeVR

- Text
- Magnification
- Contrast
- Font Selection

- Image
- Enlargement/Zoom
- Contrast/Color

- Automatic Updating vs. Manual Control

- "Placemarking"

NIH Feasibility Study Results - Form Factors

- Screen size
- Weight and portability/wheelchair mounts
- Customizable "skins"

NIH Feasibility Study Results - Content Structure/Representation

- Personal context
- Overviews/Descriptors
- Chunking
- Guided vs. Self-directed
- Bring content out of "storage"
- Mapped visual representation on screen

Self-directed was the choice when people had the time they needed for a self-directed experience, but they all said that if they only had an hour or two in a large institution, they would want a guided tour.

All want access to storage. We had also had referrals to objects that may not be in storage but were located elsewhere in the museum. The participants wanted access to the museum's full range of holdings.

People also wanted to go beyond the exhibit and obtain information about other things in the museum.

NIH Feasibility Study Results - Extended Uses

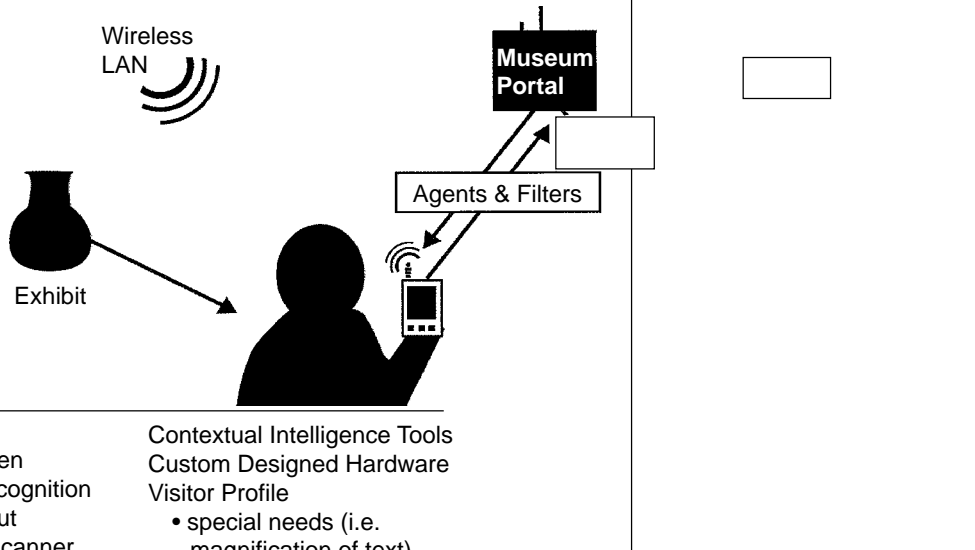
- Related programs/materials/mapping
- Ongoing personal profiles
- Notification/communication

Regarding personal profiles, people wanted a "my museum" unit that could keep track of what they saw and that they could retrieve after their visit.

We found that people are still talking to each other rather than focusing only on the speaker in their headphones. People talk to each other across the exhibits. They requested paging capabilities so that they could stay in communication with children or with companions in another gallery and arrange where to meet or the next stop.

The MUSEpad

MUSEpad Components



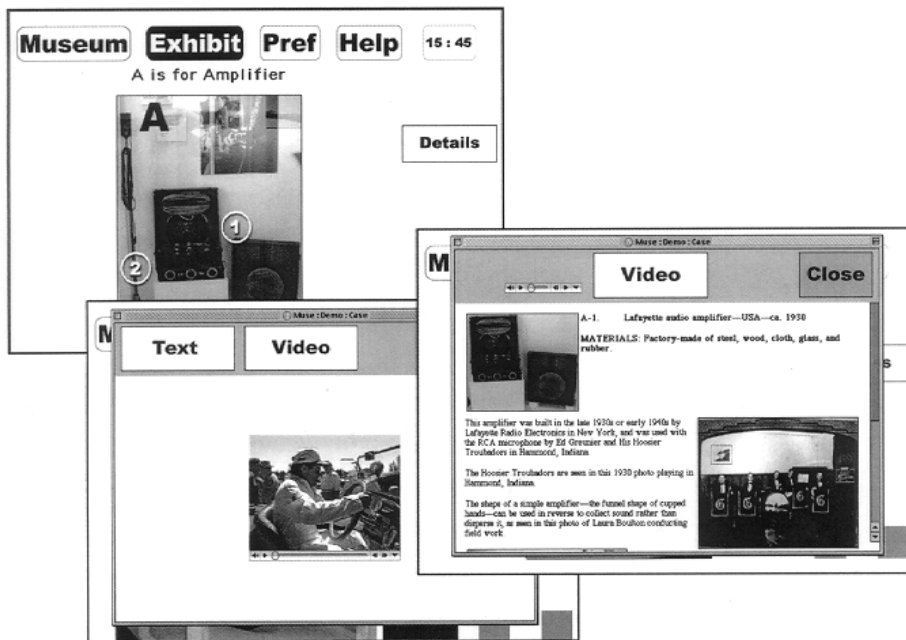
Peripherals

- Pen
- Touch Screen
- Speech Recognition
- Audio Output
- Bar Code Scanner
- Infrared
- RFID

Contextual Intelligence Tools
Custom Designed Hardware
Visitor Profile

- special needs (i.e. magnification of text)
- preferred modes of interaction (such as audio, image, text)
- age
- language
- hobbies, etc.

MUSEpad Content Representation/Access



On the screen they can see the exhibit. Standing in front of the numbers they can press the number related to an object and get choices: additional information, audio, text. They can set their preferences in advance for all audio, but some want more control – they want to be able to move back and forth between audio and text.

Future Development Phase II SBIR

- Extension of features
- Prototype development

Questions and Comments From Forum Participants

Choosing Text or Audio

- What allows visitors to access text or audio?
- Response: That's on the next screen – when they select an object they have choices.

Length of Audio/Video Clips

- How long are the clips?
- Response: They're very short – the audio is sixteen seconds and the video ten or eleven seconds.

Using Questions as Content

- In addition to information do you have something that involves questions?
- Response: That's a good idea. We had an idea called "Ask the Curator," which would involve some kind of real-time chat with a knowledgeable staff member nearby.

Prototypes

- When you were talking about prototypes, what were you referring to?
- Response: Hardware – I can't say more at this point because it's proprietary.

Fixed Devices

- Have you considered locking the portable devices to the exhibit because of weight or using terminals instead of portables?
- Response: No.

Web Sites

Electronic Guidebook Project
Exploratorium
[http://
www.exploratorium.edu/
guidebook/](http://www.exploratorium.edu/guidebook/)

CoolTown Program, HP Labs
<http://cooltown.hp.com>

Articles on museum projects
in CoolTown's *mpulse*
magazine:
[http://cooltown.hp.com/
mpulse/0901-museums.asp](http://cooltown.hp.com/mpulse/0901-museums.asp)

Hewlett-Packard Research Labs

The following people from
Hewlett-Packard Research
Labs are involved in the
Electronic Guidebook
Project: Margaret Fleck,
Marcos Frid, Tim Kindberg,
Eamonn O'Brien-Strain,
Rakhi Rajani, and Mirjana
Spasojevic.

E. Electronic Guidebook Project at the Exploratorium

- Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium
- Tim Kindberg, Scientist/Engineer, Hewlett-Packard Research Laboratories
- Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

Introduction

- Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

I wanted to frame the project for you before the presentations begin. Three sets of speakers will talk about the Electronic Guidebook Project, beginning with the Exploratorium and Hewlett-Packard, followed by a presentation from Concord Consortium.

Overall, this grant was really a research grant funded by NSF; it has not been implemented, rather we have been trying it out. Our goal is to use handheld and mobile development to deepen people's experience with exhibits before, during and after their visit to the Exploratorium. As Rob Semper said earlier, we have tried out a lot of things. That is still in process and we have more to try, but these presentations will offer you some of our current thinking.

Evaluating Nomadic Computing Tools & Technologies at the Exploratorium

- Tim Kindberg, Scientist/Engineer, Hewlett-Packard Research Laboratories

Setting and Technology

The thing about the term "nomadic" is that it simply refers to the fact that we wander around the physical world; we don't sit down in front of personal computers all of the time. This is the basic intuition of nomadic computing –

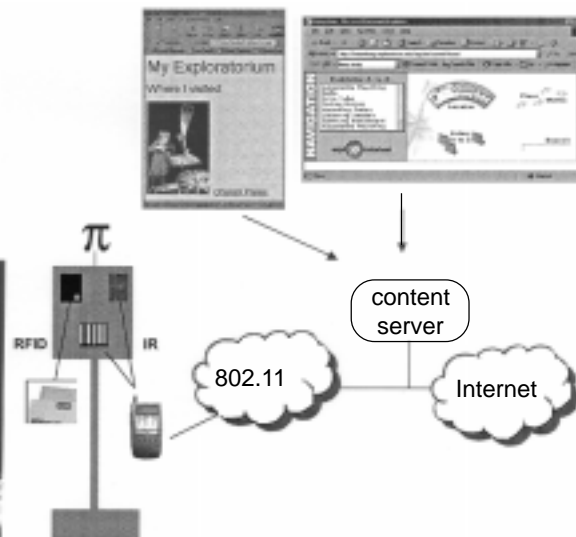
you can walk into an environment and start interacting with the world using mobile devices. I'm talking about handheld devices off the shelf: a pocket PC and the technological ingredients– bar codes, beacons, RFID. I have two on now, one around my neck, and one on my wrist.

The Exploratorium is an interesting domain for us, a physical world that is very interesting to humans. We wanted to understand how the technology we developed

Setting: Interactive Science Museum



real exhibit



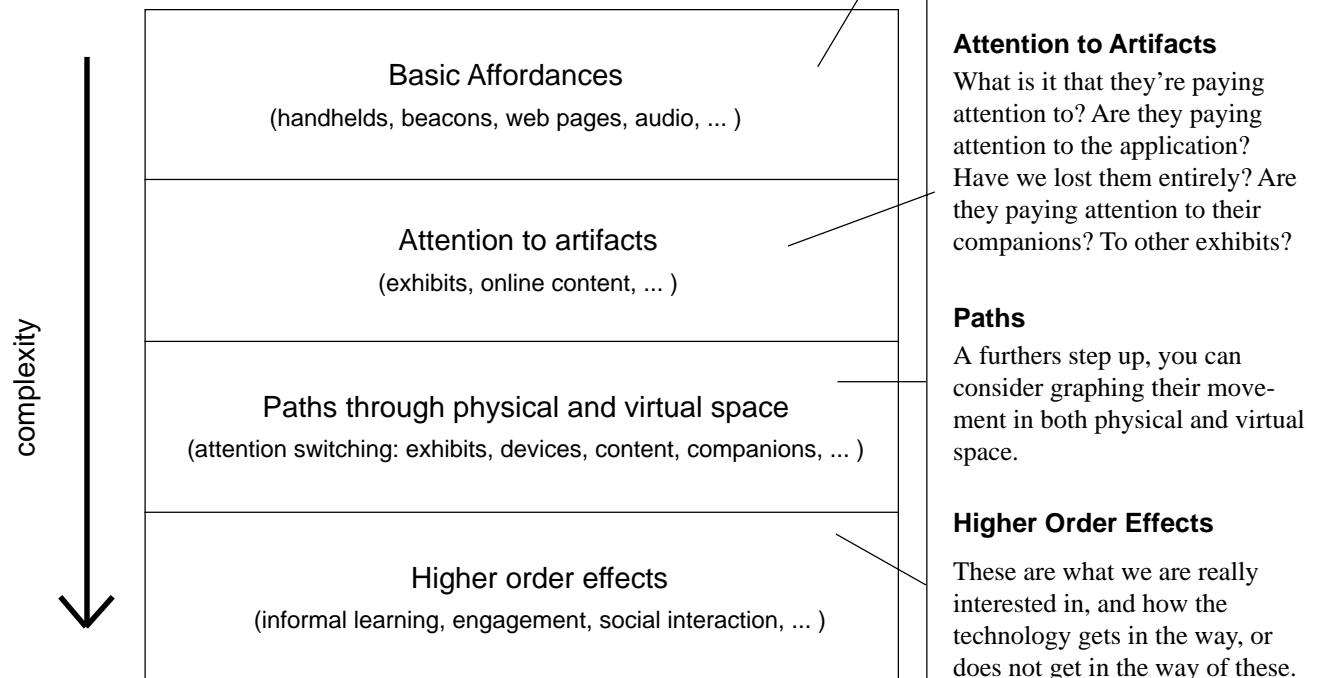
Pi-station: beacon (infrared), barcode, RFID
plus processing, I/O and networking

could play a role in that world. So we put all of this technology together. It's a little like the WorldBoard idea. Everyone is interested in finding hyperlinks on the Web. The notion of CoolTown technology is based on finding hyperlinks in the real world. By going to an exhibit you can find links (URLs) from bar codes or beacons that spit out a URL and you pick it up. This is standard off-the-shelf wireless networking.

We decided to amalgamate the technology we use into a Pi-station that includes an infrared beacon, bar code, and RFID tag. The notion is that you put one of these next to a physical exhibit. Potentially you can even have a camera on top. The visitor has something with them that allows them to interact, something very simple like a magic watch, or more complex like a PDA. The visitor can access Web pages, potentially dynamically. The idea is that there is personalization; the interaction depends on who I am, on what my interests are.

The initial phase has been a huge effort, deploying the technology, and we did that – and got some basic information on what works and what doesn't. For example, it doesn't work to have a three-pound device; we want them to have their hands free to interact with the exhibits.

Phenomena Under Investigation



Electronic Guidebook Research Equipment

Handheld Devices:

HP Jornada 690 and 720 (Handheld PCs);
HP Jornada 540 (Pocket PC); RFID tags

Specialized Hardware:

HP Cooltown beacons (each broadcast a URL via infrared)

Handheld Software:

Customized web browser to pick up URLs from beacons and allow user to bookmark to a personalized scrapbook Web page

Network:

802.11 wireless network

Server:

LINUX workstation running web server, proxy server, and HP Cooltown Web Presence Manager

In addition to access to Web pages, the visitor also has "My Exploratorium Scrapbook," something they put together, their own Web page about their experience.

Basic Affordances

This involves questions like: Can people learn to use the devices? What kind of screen size do you need?

Attention to Artifacts

What is it that they're paying attention to? Are they paying attention to the application? Have we lost them entirely? Are they paying attention to their companions? To other exhibits?

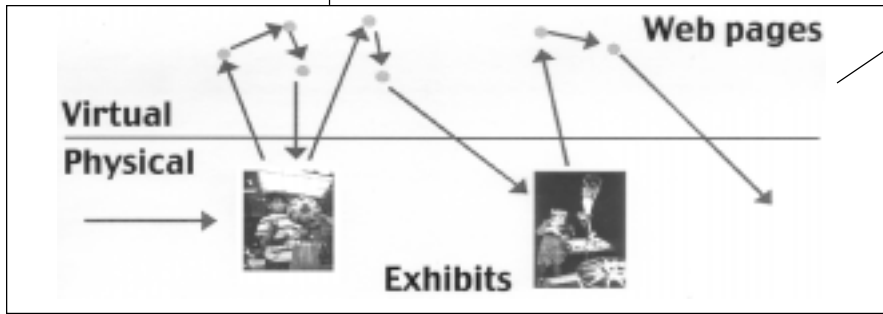
Paths

A further step up, you can consider graphing their movement in both physical and virtual space.

Higher Order Effects

These are what we are really interested in, and how the technology gets in the way, or does not get in the way of these.

Study Use of Nomadic Computing Tools



This diagram offers a picture of a visitor moving through an exhibit. At some point they move to another exhibit, which is physical movement.

Another pattern of movement in the diagram shows how a person navigated to a Web page from a neighboring exhibit. They started

- **Interference:**
how does the tool affect the amount, character and quality of attention paid to the physical artifacts and companions?
- **Efficacy:**
does the functionality of the tool match its purpose?
- **Design implications:**
which parameters of the design and the domain account for the observations made in answering previous questions?

reading and using the instructions for that exhibit while still physically at its neighbor, so they became lost in physical and virtual space.

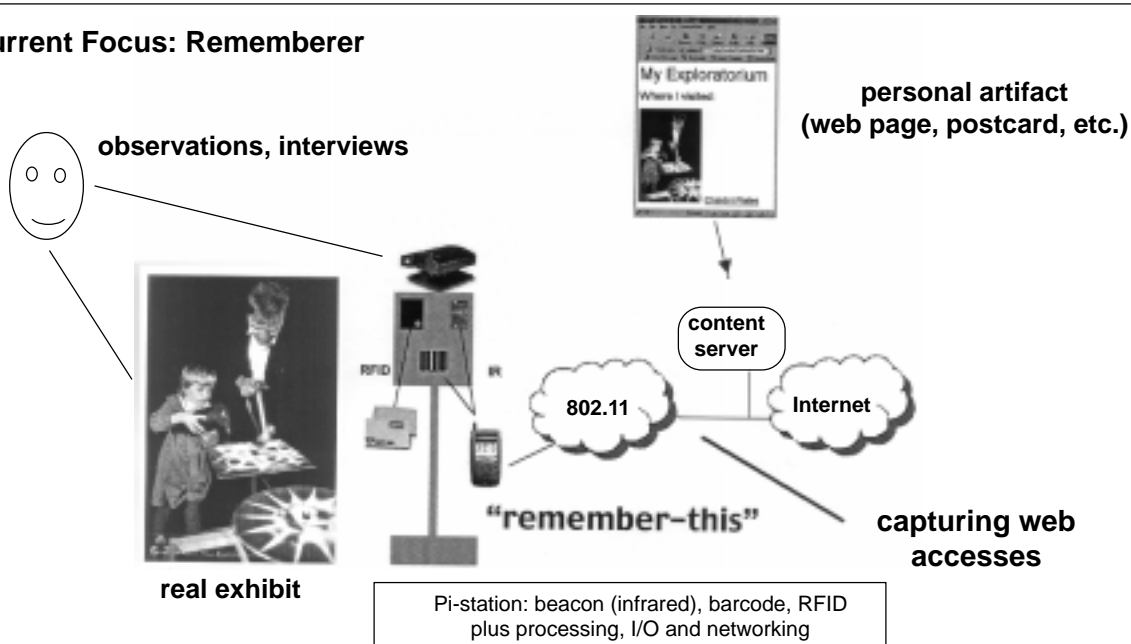
We feel these tools are reasonable ideas that make the experience even better. The “Informer” is a tool that tells me more about things that are in front of me. The “Suggestor” suggests that I might like to do certain things with this exhibit, or where I might like to go next. The “Communicator” allows communication with my school group, with people standing near me, or with others in the museum. The “Rememberer” helps me leave the experience with something that helps me get back into that experience. It’s not a souvenir, like an Exploratorium snow globe, it’s something that recalls the details of the experience. That might be photographs, details of where I went, and so forth.

Tools to make the experience better:

- “Informer”
- “Suggester”
- “Communicator”
- “Rememberer”

This list represents questions about the use of nomadic computing tools. What interferes with the things I want to do? In terms of efficacy, does it have anything like the functionality we designed? Regarding design implications, we are all using off-the-shelf equipment – what kind of thing would be really important? Can we map demand and functionality into something completely different?

Current Focus: Rememberer



Current Focus: Rememberer

On the Hewlett-Packard side, our current focus is the “Rememberer,” a way to construct for myself a personal record of my experience. For example, a bookmark to remember aspects of the world as I go around. I could take my picture, or take a picture of something of interest to me.

We’re also working on “remember-this” technology which allows people to remember this or remember that. We’re about to experiment in detail with what the “rememberer” really achieves and what it promotes regarding remembering scientific phenomena and so forth.

Exploring Electronic Guidebook Content & Use

• Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

What Content?

When I joined this project nine months ago, the wireless network and devices were working, so people on the project said, “Let’s start testing it.”

I asked, “But what’s going to be on it? What are people going to do with it?”

The response was that the Exploratorium has tons of Web pages it has developed over the years on different exhibits, as well as exhibit text. Others said, “We’ll use that for the content.”

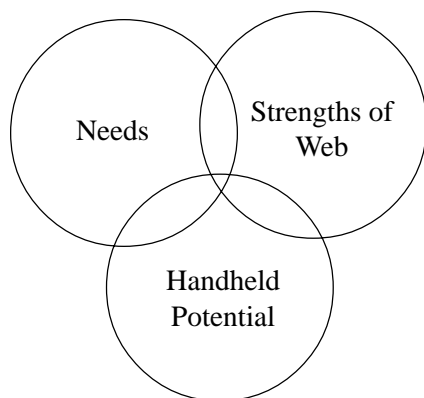
The problem with the word “content” is that it’s a noun. Thinking of plugging in content doesn’t answer the question about activity: What are people going to do with this device? Are visitors going to use it to read more about the exhibits, to see more things to try with the exhibit, to interact with simulated models of the phenomena, to send messages about the exhibit to friends and family, to view real-world connections, or for something else?

I had heard that exhibit developers were skeptical about this project. So Karen, Mike, and I met with a group of them. These developers have thought deeply about the exhibits they’ve worked on, and some of the exhibits deliberately have no labels. Jamie Bell, who manages the physics exhibit area, said, “The Exploratorium has had nine different initiatives that concentrated on mediating

the exhibits for visitors. How does this relate to and build on those? What need is this trying to meet?”

Jamie added that although many initiatives have worked on mediating exhibits for visitors, there haven’t been any initiatives to help staff learn more about exhibits. Teacher, high school Explainers, college Explainers, and other staff are interested in learning more. Is there a way to use the Web and

What Makes Sense To Do With It?



Take-Away Tokens

There is a refrigerator magnet that can take away that actually has the URL for my Web page. There’s also a jigsaw puzzle version. There are various things you can imagine that people could take away – postcards, screen savers – all of which ultimately refer you back to your “My Exploratorium Scrapbook” Web page.

VERBS

(What do you want to do with the handheld device?)

Needs/Opportunities

- Connection between exhibits
- Reflection on learning
- Couple of exhibits pique interest
- Extend learning before, during, after visit
- Wealth of knowledge on exhibits

Strengths of Web

- Access to information
- Express ideas
- Ability to search
- Asynchronous communication
- Collaborative potential
- Simulations

Handheld During Visit?

- Information vs. Experience
- Technology vs. Phenomena
- Right Answer vs. Exploring/Experimenting
- Future vs. Present

About the H.P. “Rememberer”

What’s exciting is that it focuses on an activity: remembering – not just providing information. It potentially is appropriate for first-time visitors. It complements the other developments we’re working on for teachers and staff.

handheld devices to provide access to the wealth of existing knowledge about the exhibits?

Some Exploratorium staff offer floorwalks, guided tours of selected exhibits that highlight specific concepts or themes. Perhaps handheld devices make floorwalks available, to help more people see the connections from one exhibit to the next.

Could the devices be used to help people reflect on their learning in the Exploratorium?

Web pages tend to emphasize information, while exhibits involve visitors in an experience. Can we use these wireless networked devices to enhance people’s experience during a visit, not just provide more information?

Many kids prefer playing games online to reading web pages. So, several people have suggested making online games for kids to play in the Exploratorium. But the Exploratorium is a unique multisensory learning environment. Do we really want young people focusing on computer monitors when they are here?

We asked teachers to try the handheld computer over the summer. These are thoughtful and experienced science teachers. More than one teacher suggested using the devices as electronic question sheets for students to fill out during a visit. The technology could keep track of which exhibits students went to.

This idea concerns me. Frank Oppenheimer said, “No one ever flunks a museum.” I don’t want handheld computers to make it possible for students to flunk the Exploratorium. I am afraid using computers as worksheets misses the potential of a visit to the Exploratorium and the technology.

Then there is the question about using devices to record things to look at after your visit. This raises the issue of future versus the present. A museum is one of the few places where you are immersed in an experience in the present moment. By introducing technology for remembering things later, are we taking away from the present experience?

Sample Content

- Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

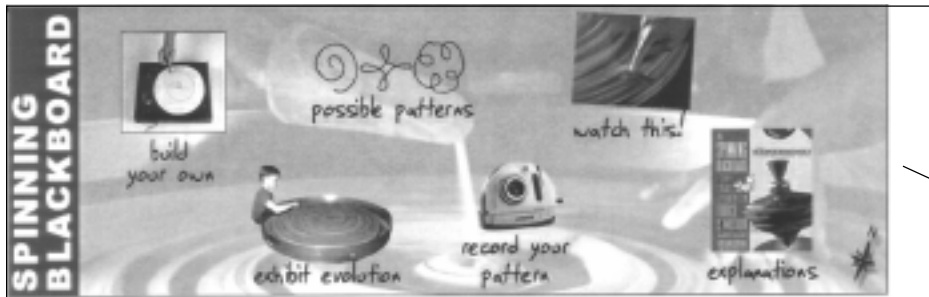
The content I will be showing reflects the point we’re at in understanding the plethora of information around an exhibit. The idea is to be able to wander through and find what’s useful for us as explainers, as staff, as teachers.

Spinning Blackboard Exhibit

This exhibit involves sand on a spinning disc. You can pick up more sand with a scoop and pour it onto the disc, create patterns in the sand with your fingers, and so forth.



Imagine having a handheld device with this exhibit. A lot of this extra stuff has very little meaning until you've tried the exhibit itself.

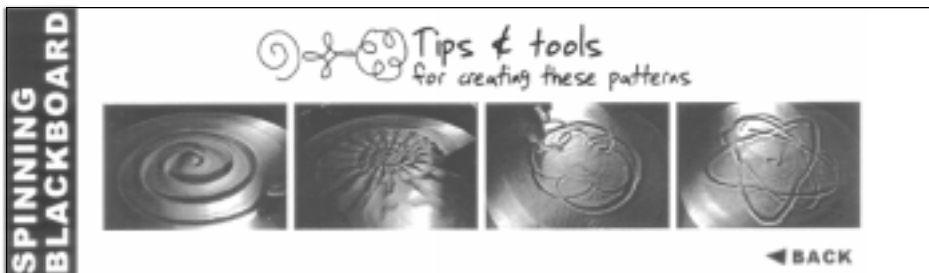


All of the examples are arranged in the same way – it tries to involve you in the exhibit.

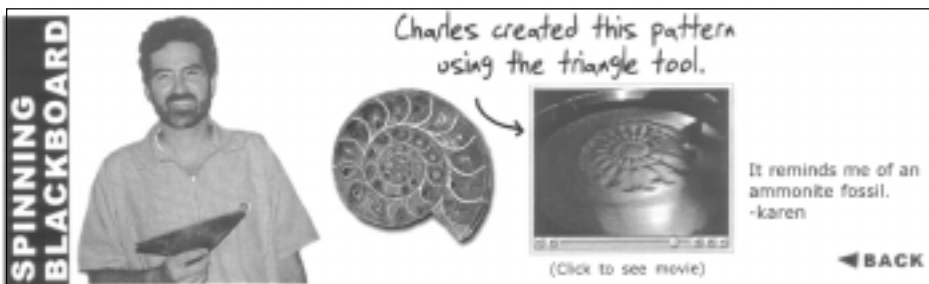
There are little pieces called “nuggets” – little pieces of information that are thematic, and things that are adjacent to the exhibit that you can explore while there or at home.



For example, “galleries.” This link brings you to a gallery of sand patterns that people have created in the past. In some cases we have video clips of how people created something, why they created something, that might inspire you to go back to the exhibit and experiment with it some more.



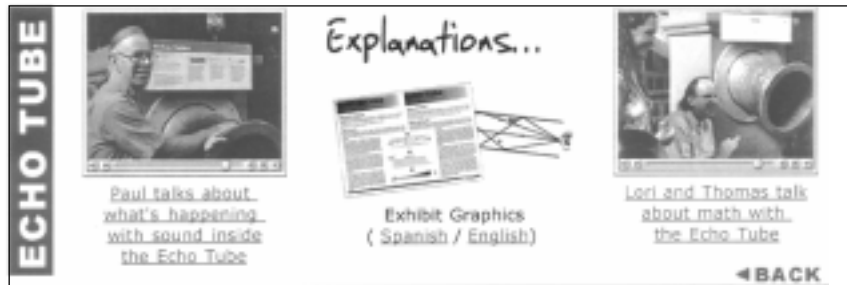
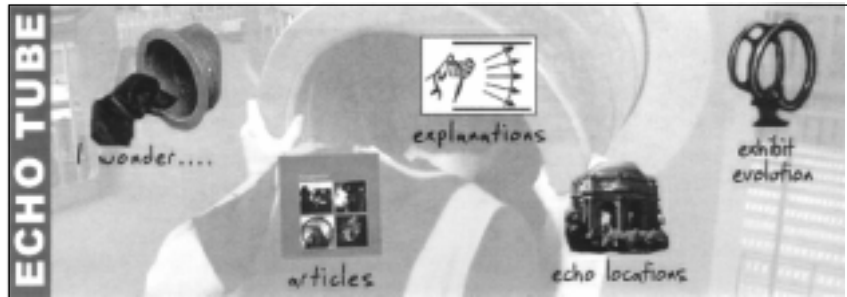
Another example is a link to the Exploratorium's *Snackbook Series*, which has lots of ideas about things to do at home that are related to the exhibits. Here we have a bookmark into the online *Snackbook*.



Another nugget involves taking a picture. You can record and save, capture an image of what you've done – and maybe share what you've done in the online gallery.

We're hoping to capture images created at this exhibit – it's a work in progress!

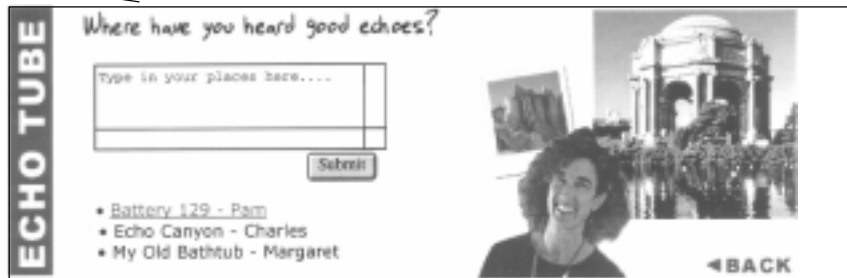


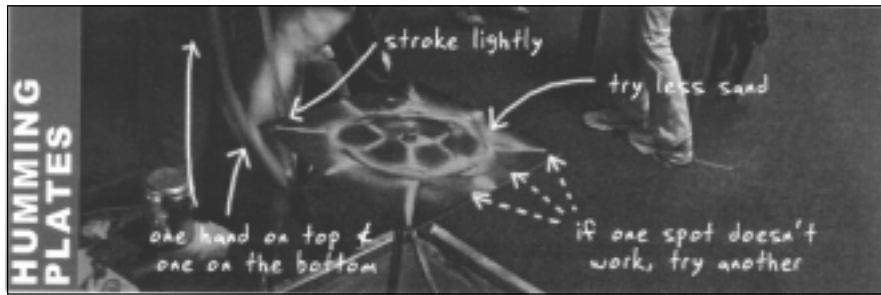


Another idea is to see if we can collaborate with visitors with real world connections. For example, "Where have you heard echoes?"

The example here is from a staff member, Pam Winfrey, who is singing in a tunnel. [In the movie link, you can hear Pam singing in the tunnel.]

We want to inspire people to add their own ideas and memories.

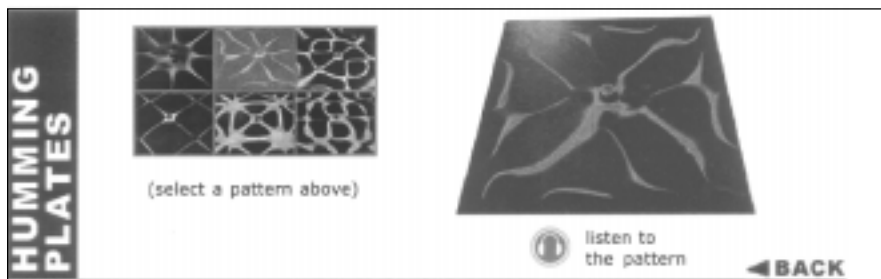




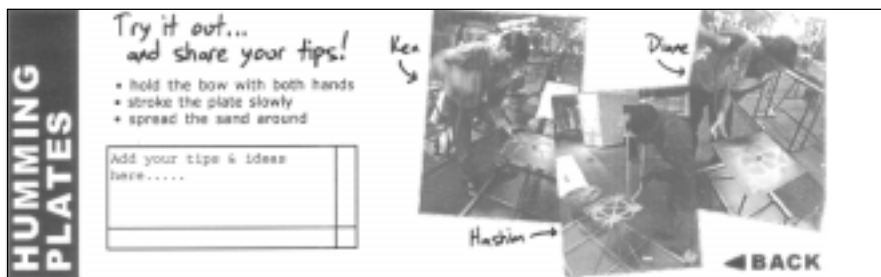
This exhibit is a staff favorite, but it's one of the most difficult exhibits for visitors to work. We tried to figure out suggestions to help visitors out, and asked staff members for their tips.



In this case the nuggets involve tips from different staff members doing it in different ways.



These are examples of the things we have been trying to pull together based on existing experiences with exhibits.



Questions and Comments From Forum Participants

Marketing

- Have you thought about how to market some of this?
- It's a matter of knowing, when you're standing there, that you can make something at home.

Testing Handheld Versus Stationary

- Have you done any specific studies or thought about how to test what would be appropriate to a handheld device versus having something permanently mounted there?
- Natalie Rusk: I feel it's not for everyone, not for the first time visitor. If you come up to the Echo Tube and there's a computer screen, the reaction is going to be "what am I *supposed* to do" rather than just yelling into the tube and trying it out.
- Tim Kindberg: We have been talking about two things: the experience at the exhibit, and the experience once you're back at home or in the classroom. But there could also be a kiosk on the floor where you could go to look at your "My Exploratorium" Web page and see how it is looking so far.

F. Electronic Guidebook and Concord Consortium Probeware

- Stephen Bannasch, Director of Technology, Concord Consortium

Introduction

The Concord Consortium is a nonprofit, tax-exempt, educational research and development organization that works on adapting and developing technology to serve all learners. We have been in business since 1995 and have thirty-five employees, with locations in Concord, Massachusetts and Shelburne, Vermont. One focus is on sensors, modeling, and handhelds. Other work includes online learning and professional teacher development.

Projects

We started working with the Exploratorium and had a vision and continued forward with the idea of using sensors in a museum setting. For example, building sensors into exhibits, with data displayed on computers.

Current projects contributing to the development of CCProbeware:

- Data and Models
- Electronic Guidebook (Exploratorium)
- TEEMSS (Technology Enhanced Elementary and Middle School Science)
- Modeling Across the Curriculum

Data and Models Project

The Data and Models project involved use of a thermal conductivity system to explore how we model and how kids look at model representations. A Probeserver collects data from probes, and makes that data available over the internet.

Our system for investigations of thermal conductivity and thermal gradients in

Web Sites

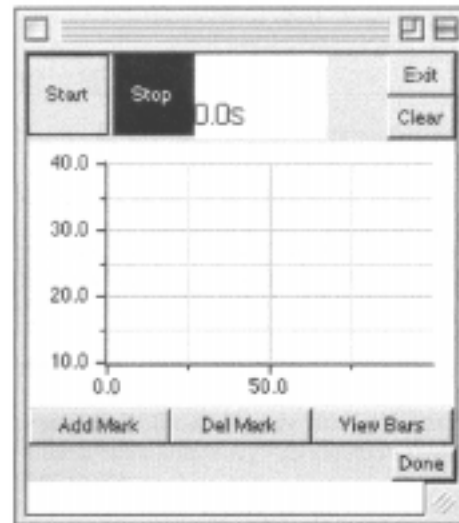
Electronic Guidebook Forum
Slideshow Presentation:
[http://concord.org/
ccprobeware/guidebook/
slide1.html](http://concord.org/ccprobeware/guidebook/slide1.html)

Probeserver and the Data and
Models thermal conductivity
system:
[http://concord.org/data-
models/conductivity-
system.html](http://concord.org/data-models/conductivity-system.html)

TEEMSS and CCProbeware
[http://concord.org/
ccprobeware](http://concord.org/ccprobeware)

different materials involves small blocks of aluminum, stainless steel and nylon with temperature sensors embedded within the blocks. The blocks can be connected together to form simple or complex two dimensional arrangements. We have also created thermal actuators which can pump heat into or out of the system. Data are taken from the thermal network and broadcast wirelessly by a Java microcontroller to any student with an iPAQ interested in visualizing the change in temperature gradients over time.

Our second effort involves the creation of a tiny ultra-fast response temperature probe for investigation of the surface temperature of objects in the environment.



TEEMSS and CCProbeware

Software :

- Probeware
- LabBook
- Collaboration
- Aggregation
- Analysis
- Review.

The software we have developed runs on any system you might have. The software uses WABA and runs on Palm, Pocket PC, Mac OS, Mac OS X, Windows, and Linux.

The initial TEEMSS activities are explorations into force and motion and energy transformation. We adapted the ultrafast response thermocouple temperature sensor developed for Data and Models. Specific TEEMSS sensors include:

Fast Response Thermocouple Temperature Probe

<http://concord.org/ccprobeware/fast-temperature/fast-temperature.html>

The probes we developed have a fast response. There are many experiments you may want to do that you can't do with a normal probe because the response time is two to three minutes.

Force Probe

<http://concord.org/ccprobeware/forceprobe/forceprobe.html>

Includes a detachable magnetic field sensor. This is based on applied force. Positive or negative forces are applied to the free end of an aluminum beam which produce displacements proportional to applied force. With this probe you could, for example, have a person sitting in a cart, attach the force probe to the cart, and pull me across the carpet, using the probe to measure the force it took to pull me.

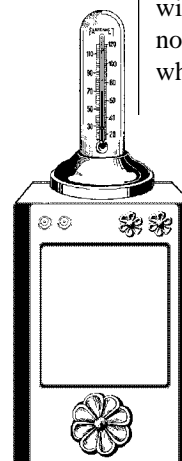
Smart Wheel

<http://concord.org/ccprobeware/smartwheel/smartwheel.html>

(0.15 degree angular resolution, max linear speed 5 m/s)

The SmartWheel is used for measuring velocity and with additional processing produces position and acceleration data. In addition it can be used to measure angular rotation such as that produced by a pendulum. It uses a CD ROM with a simple bearing on the hub and an extended shaft to either hold or attach to a moving object. We measure the rotation using optical quadrature methods.

Kids make a cardboard cart with this in front, and can now measure what happens when you add mass.



Probes for the Electronic Guidebook Project

Additionally for the Exploratorium Electronic guidebook project we are creating:

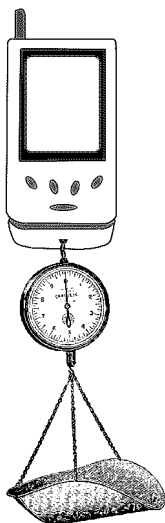
- A multi-spectral light probe
Light is ubiquitous; we need light to see. It would be interesting to look at light at different wavelengths.

- Pressure probe
A number of exhibits here use pressure.

- Sound
You could, for example, using the Echo Tube exhibit that was described earlier, clap and make a particular tone, see a representation of the sound wave, and see a change when the echo returns.

2 probe ports, each port includes:

- 2 slow (3Hz) analog inputs with a 5 micro-volt resolution
- 2 fast (400 Hz) analog inputs with a 2.5 milli-volt resolution
- 3 digital I/O lines



Voltage and Current Probe

<http://concord.org/ccprobeware/voltage-current/voltage-current.html>

This can measure voltage and current simultaneously. The product of these measurements is Power in Watts and the integration of Power over time is Energy in Joules. The probe measures +/- 20 volts and +/- 2 amps. The different values are reported by the probe simultaneously to both the fast 10-bit and slow 24-bit input channels of the probe port. The probe and interface only collect voltage and current readings. The CCProbe software can use these data to calculate and display Watts and Joules.

Light Probe

<http://concord.org/ccprobeware/light/light.html>

The TEEMSS Light Probe has two measurement ranges: 0-4000 and 0-125000 Lux. These ranges are reported by the probe simultaneously to both the fast 10-bit and slow 24-bit input channels of the probe port. The sensor is a silicon photodiode with an integral near-IR blocking filter. The sensor gives the light probe a response mainly in the visible and as such it is designed for measuring illumination or photosynthetically active radiation used by plants (PAR).

CCA2D2 v2 Interface

<http://concord.org/ccprobeware/cca2d2-v2/cca2d2-v2.html>

data collecting modes:

- real-time data samples from probes sent immediately to computer
- long-term datalogging, data collected and saved by interface and sent later to computer
- oscilloscope, high speed (up to 10kHz) triggered data sampling sent at intervals to computer

Portability is key. It is small, can operate on batteries, has places for two probes, and can connect to a computer. It also works separately from a computer. You can leave it to collect data and then hook it up to a Palm or other device.

Criteria included how much of a headache is it to use. We try to minimize the number of parts

involved, and if the batteries are dead you can connect it to the serial port of a computing device.

Currently the CCProbe software works with the CCA2D2 v2 interface, however the software is designed to support selecting different interfaces.

CCProbe Development

License

CCProbe software has been developed by the Concord Consortium and is licensed as open source. Anybody can use it freely and you can make as many copies as you want.

You can also get copies of the source code and if you are inspired, make changes and add capabilities. If you do this, the open source license we use requires you to make those changes available to others under the same license.

Future Capabilities

In the future you will have the capability to not only save data on an iPAQ but you can access a server so that it is on the Web. You can go to a Web page to access the data. We also want to run it as an applet. You can connect to a server and any computer that can run Java can run the software.

One reason that we made the software work on a range of different computers is because we had developed software for the Emate. A week before release, Apple cancelled the Emate. The fact that you can move from system to system has been very useful, as well as the fact that you can move between a handheld device and a larger computer. Investigations are what I'm talking about – the process of collecting, observing, and so forth. It is a lot easier if you can do the report writing on a larger computer.

The architecture is based on what we call a LabBook. The LabBook includes different kinds of objects: a folder; notes (a text object); a question object (you can add questions learners or users could answer); a data collector that allows you to graph data from probes; drawing (you can draw); a unit converter; image (you can put images into a LabBook on a desk top or it can be connected to an imagegetter connected to an exhibit that you put in your LabBook). So you have access to different kinds of objects or you can create a new object.

Sample Demonstration - Using an Ultra-Fast Response Temperature Probe

I have set up a probe that is graphing the temperature of two materials, aluminum and styrofoam, that have been sitting in the room. They are the same temperature as we start because they have both been sitting here at room temperature.

A classic misconception is that metal objects are colder than plastic objects. The ultra-fast probe can in seconds measure the actual surface temperature of the metal and styrofoam and determine that they are the same. The experiments become much more interesting when the temperature of the surface of the skin is measured both before and after touching the aluminum and the styrofoam.

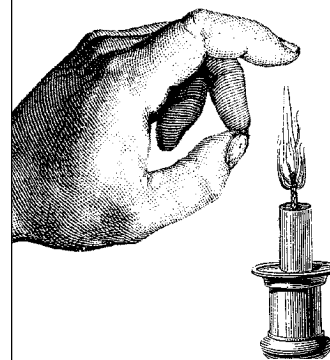
I'll see what happens when I put my finger on each of the materials. The starting temperature is 24 degrees for both the aluminum and the styrofoam. If I measure the temperature on the tip of one finger as it touches the aluminum, I can see that the temperature is about 27 degrees and slowly cooling. So heat is going from my finger to the aluminum and my finger is getting colder and colder. If I try the same experiment with the styrofoam, the heat in the tip of my finger goes up to about 30 degrees. The surface of the finger that touched the aluminum cooled more than the finger that touched the styrofoam. This kind of representation offers a visual graphing of the results of an experiment you just did in real time with your own body.

Future Capabilities

- Probeware - more display modes including:
 - two Y axes
 - XY scatterplots
 - table display
 - data transformations and analysis tools
- Display of data collected on another networked device
- Network synching of LabBook components
- CCProbe and Browsers:
 - Helper Application - Opening a specific CCProbe LabBook object by a browser as directed by html
 - Applet - running as a Java applet inside a browser

Future Work/Projects

- TEEMSS
- IERI Modeling Across the Curriculum
- Open Sources for Education



*A finger is the first
temperature probe that
everyone uses.*

A Question of Costs

For those of us just poking around and getting started, I'd like to know the basic scope of these projects and the resources needed. I couldn't tell from the presentations whether they were \$15,000 or \$150,000 projects, and that is the first thing that executives want to know. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Exact figures may be difficult. Maybe we can talk in terms of time and personnel. • Rob Semper, Executive Associate Director, Exploratorium

Maintaining the Equipment Over Time

Q: How many people have used the handhelds?

A: We don't know the exact answer to that yet, but about twenty-five a day, and at times it's busier.

Q. The show has been up for five months now? That's significant – 25 x 5 months.

A: In terms of breakage, at one point we had a lot down but that's rare. At that time we didn't have the resources to get them up and running.

Q: So to keep them running it takes one full time person to check them in and out, and a support person who is not full time?

A: Yes

G. A Rough Comparison of Project Costs

Points of Departure San Francisco Museum of Modern Art

Budget

\$25,000 for equipment

\$10,000 for programming and design (We would have needed \$35,000 if our time and budget allowed for custom programming)

\$15,000 for content development rights

Staffing

- Design/Production Staff
Equivalent of 5 FTE for 2 month development period; an additional 8 FTE for 2 weeks of launch.
- Exhibit Staffing
1 FTE, all museum hours; and backup and support
- Evaluation
1/2 time for length of show

Staffing/Equipment/User Issues

Someone earlier mentioned the point about getting buy-in from visitor services. Since we started so late in the game we were caught a little off guard in terms of staffing it so it was a bumpy ride for a couple of months until they were able to get enough people. So visitor services is another whole factor and you have to cater lunches, get into logistics.

Then there is the issue of getting technical support for our IT department. It's a new thing for them to support these devices. In terms of software problems we worked with the programmer to solve those. There are probably four broken right now. In terms of hardware, only one was completely totalled (it rattles). But we have seen people drop them. We've had to reload and reboot twelve of them since March. Also, the top of the styluses tend to break off but they came with spares. When the tips break off the styluses, the screen can get scratched. The attendants check all components as people turn them in before they get their credit cards back.

Sotto Voce, Xerox PARC

We were a research project so ours is a bit different. Regarding programming time I would say 3 months for the two prototypes we built. Content development and working with the curator on the script involved about 60 hours over 50 objects in 3 different rooms. The iPAQs cost about \$1,000 each.

Q: How many people total?

A: At various times, including interns, 6. We started with 2 or 3 and then more joined. Almost everybody was part time.

Q: How many full-time people does that add up to?

A: Say 2.

Q: Are you counting the time of the Filoli curator?

A: Their time was probably well under 60 hours; it was minimal, a few hours here and there. To do the content development, I interviewed him.

Kid Club Communicator, Port Discovery

Staffing & Budget

For myself and the museum staff developing activities it was probably 200 hours total.

The software development was 400 hours total and I think we had about 5 people working on that.

In terms of hardware we had just under 100 Blackberries at \$400 apiece so that would be around \$40,000.

Additional costs involved PCs for log in and server time, which was whatever they wanted to charge. Retail it would be \$40 per month times 100 pagers, or \$4,000 per month.

It's important to stress that there was a lot of museum staff time that was not dedicated to the project per se, but involved the education department reviewing language and so forth. People from the local schools also spent a lot of time reviewing the content.

Equipment Issues

There are typically 40 Blackberry Pagers on the floor, and even that's not typical, but a school group usually consists of about 30 on the floor. The rest are recharging or sitting idle. There is always someone staffing the checkout/check in, and as I said earlier there are security issues surrounding that.

In terms of maintenance problems, because the software is coded into the device we have no problems with that. And the devices are robust – they've survived a two-story fall. The real problems lie with the connection to the server. There isn't a large IT staff – one person is dedicated to this.

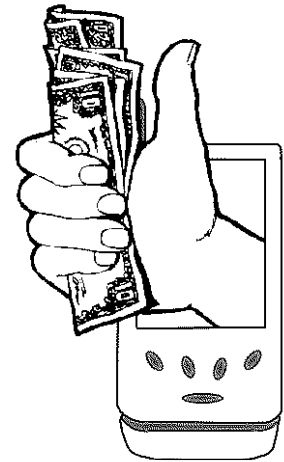
Q: You are talking about dropped connections and the server being rebooted?

A: Exactly, it's wired into their network.

Q: So the issue is more that the museum's network goes down?

A: Yes, and it affects the visitor experience.

Q: How often is that a problem?



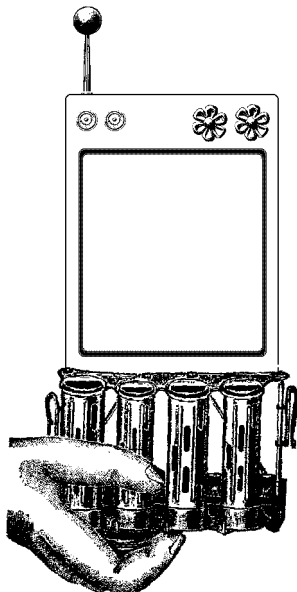
MUSEPad Mathers Museum of World Cultures

\$100,000 over 6 months time, approximately \$75,000 direct and \$25,000 indirect funds.

Of the \$75,000, \$60,000 was spent on salaries and benefits for 8 staff members (working part time on the project, 5 consultants, and compensation for participants. The remaining funds were spent on travel and some equipment (much of the equipment used was loaned to the project).

Limiting Equipment Investment During Techno Flux

- From the device point of view we experimented with different devices, and only got a few of each to experiment with.- Rob Semper
- Q: Was your equipment funded externally?
 - We had a grant and also an equipment support grant through Hewlett-Packard, and we used some devices that we had. One factor is that the devices themselves keep being revised and they come up with a new version with more capabilities, so the field is churning, which is why we're not buying a huge number of any one kind.- Rob Semper



A: The server at Aether is a continuing problem – it's not a priority for them. It's not every day, but once a week and then it's down for three to four hours, so pretty much the whole day is shot.

Electronic Guidebook Project Exploratorium

- Our costs involved everything from development to protocols for dealing with visitors. - Rob Semper
 - The user studying part is huge. We have three summer interns working exclusively on that. - Mirjana Spasojevic
 - The Electronic Guidebook is a testbed project. Version one testing took a whole set of time, so that was six to nine months of stuff that is interesting for historic purposes. During the first year of the project, we had three staff people from the Exploratorium working part-time focusing on the network and technology issues. For the past year, we've had a project director working 80% time, then five other staff people helping part-time (two on content and web development, two on technical issues, and one on evaluation). - Rob Semper
 - There have been ten people each from the Exploratorium and Hewlett-Packard, with five or six core people from each side but about 20 total. - Margaret Fleck
-

Concord Consortium

On our side we've had essentially two other projects with similar hardware goals to the Electronic Guidebook project that involved developing probe interfaces for handhelds. We have been able to leverage all three against each other. Our problem lies in the area of hardware and software development. There is seldom money from NSF for doing that, so we bootleg what we can.

Basically this is a half-million dollar job, but that is spent over several projects. Very little of that half-million is spent directly on the Exploratorium Electronic Guidebook project. • Robert Tinker, President, Concord Consortium

IV. KEY ISSUES

During this portion of the forum we will start by trying to get ideas out on the table by having each person first address the discussion questions. We will then try to "bin" the ideas into categories. • Rob Semper, Executive Associate Director, Exploratorium

A. Goals/Overarching Issues

Why do this? Does it fundamentally add to what we're doing?

- One question I think we all have to ask is why – why are we doing this? Is it just because the stuff is out there and we're hip and cutting edge, or is this adding something fundamentally? • Daniel Molitor, Consultant

Return on investment - ours and our visitors

- One thing that concerns me is will it always be a significant investment on the part of the users to make it work? Will return on our institutional investment in terms of time, content, and development be on a level that is only usable by larger institutions, or will we end up producing something great and then larger institutions like Disney say "Thanks," and go in that direction? Or do we realize in the end that really the way to do what we're trying to accomplish is to give teachers clipboards which gets us ninety percent of the way there with ten percent of the investment? We need to be honest about this. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Ubiquitous versus portable

- I have heard some very interesting questions regarding: What is this for? Why are we developing this? I would like to come back to a more basic simple question about the how. I would like you to think about ubiquitous and portable computing.

With ubiquitous computing you would have the computing devices everywhere. You wouldn't carry them with you. You would find an appropriate location and presumably you would have the capacity for more computing power. Whereas with portable computing you clearly have a much more fragile, limited tool.

I wonder if, by not articulating the difference between portable and ubiquitous, we are not in danger of being captured by the gadget, by the portable. So clearly this is half a "how" question and half a goal question. • Goéry Delacôte, Executive Director, Exploratorium

Discussion Questions

1. What aspects of using handheld computers in museums do you find most promising?
2. Which aspects concern you the most?
3. What unanswered questions do you have about using this technology in museums?

Categories

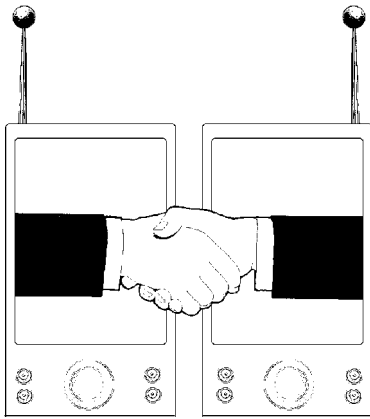
- Goals/overarching issues
- Audience
- Technology infrastructure
- User interface
- Content development
- Staffing and operational issues
- Research and Evaluation (visitor studies)

The role of the museum in society

- What is the impact on the museum's goal? How does this technology affect the overall goal of how the museum wants to position itself as an institution in society? • Daniel Molitor, Consultant

Potential for collaboration

- The collaborative possibilities that these projects pose are exciting. • Kristina Hooper Woolsey, Consultant
- That is something we have yet to talk about in this forum – the relationship between institutions. • Rob Semper, Executive Associate Director, Exploratorium



Vertical or horizontal design and goals

- In various examples that were talked about today, models were linked to different goals. There was a vertical arrangement in which the electronic device is part of the design of an exhibit. In other examples, it was a horizontal arrangement, spanning across the whole museum so the visitor carries the device across different settings. This choice between the vertical and the horizontal might be something you want to do specifically rather than accidentally. • Jim Thornton, Member of Research Staff, Xerox PARC

A museum-embedded design or a personal exploration tool?

- I am wondering whether these things should be designed for museums and embedded in the museum's philosophy and ideas, or whether it could be a notebook you bring with you and it changes the way you receive things and the way you collect things. For example, here at the Exploratorium you may gain ideas and information about color and light. Then you go to the San Francisco Museum of Modern Art and look at paintings involving color and light and you make connections between the two. • Susan Schwartzberg, Senior Artist, Exploratorium
- That's sort of inside-out or outside-in design. • Kristina Hooper Woolsey, Consultant

Changing/expanding the role of the visitors

- It changes the role of the visitor. I felt that I can be a visitor, a curator, a researcher, a content provider. It changes and defines the role of the visitor. They can have specific roles when they walk around the museum and outside the museum because they have this tool in hand. • Andrea Bandelli, Museum Consultant

B. Audience

1. Promise/Potential

Opening & enhancing the experience for people with different abilities

- For me the most promising aspect of this technology is its potential to somehow enhance the experience in the moment. The capability of recording and of planning ahead is certainly possible and may be valuable, but for me to open up, to enhance the experience in a way we wouldn't otherwise be able to do, particularly for people with different abilities, is the most promising. • Daniel Molitor, Consultant

Portability and multiple access - visitors develop their own vernacular

- The appeal is the portability and multiple access that gives me and visitors as much information as possible so that we can develop our own vernacular. • Melissa Alexander, Project Director, Origins, Exploratorium

The visitor as a VIP with a personalized experience

- One of the things we're hoping to see in terms of potential is to offer each visitor a VIP experience. We want to figure out how to make every visitor feel

like the place was set up for them each day. What are ways that we can add value to the experience. With a lot of what I've seen it seems like you could simply add a kiosk – the information is not unique to individual visitors. You could say, "I know you've seen this exhibit, so here are six others that relate to this exhibit." • Rachel Hellenga, Director of Exhibits, The Tech Museum of Innovation

Visitors as curators

- I was at a Jackson Pollock exhibit at the New York Museum of Modern Art and started talking to a man who was seventy years old who was telling me about his memories of Pollock when he first became known, how there were Pollock-imitators. I like the idea of visitors contributing as opposed to staff – visitors as curators. • Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories

2. Unanswered Questions

Accommodating casual visitors

- How do we accommodate casual, drop-in visitors with one of these devices? • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Who is the audience?

- We're not asking who the audience is. Is it children, students, adults? • Margaret Pezalla-Granlund, Museum Consultant

Audience goals vis a vis content, engagement, technology and space

- If we're going to look at how to meet visitors' goals we need to look at different kinds of content and ways of engaging them and the different goals you can accomplish with technology in that space. • Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago

How much training does the visitor require?

- This is a mundane issue and it involves training. How much is required? What can you assume about their knowledge and what are your expectations for your audience? • Mirjana Spasojevic, Project Manager, CoolTown Program, Hewlett-Packard Research Laboratories

Staff-driven development or audience-driven development?

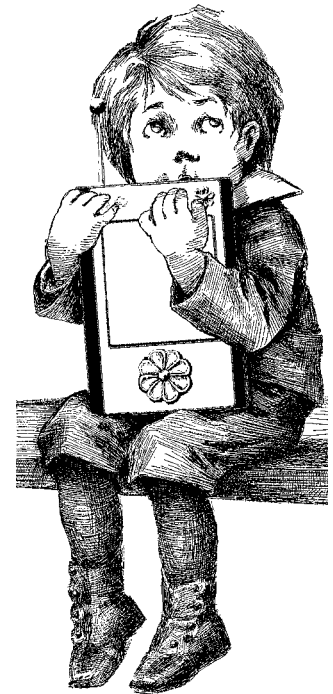
- When I'm teaching a class it's not because the classroom has cool little computers; it's because I have an interest in the subject I'm teaching, and I'm assuming with exhibit developers it is the same. I wonder how much the audience drives what is actually built and how much it is driven by our personal interests and expertise. • Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

Visitor input – for content building or evaluation?

- Do we want to allow users to leave their stories behind so that there is a growing legacy of information, experiences, and insights? Or do we see it as an opportunity for evaluation – the visitor finishes an experience and we ask, "What do you think?" • Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago

Overlapping Issues From Other Categories

- Need to enable visitor input to content & the information base
- Does the technology create an isolated visitor experience?
- If we are profiling our visitors via these devices, does that raise privacy issues?
- How do the demographics of the audience affect the type of experience they'll have (age, gender, digital divide issues)?



What impact does the age of the visitor have? Is it multigenerational?

- How is it different for kids than for adults? Is it multigenerational? • Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

C. Technology Infrastructure

1. Promise/Potential

Information storage on the Web

- Something that was alluded to that is promising relates to the question of what you store locally and what you store globally. The Web can be a set holder. • Kristina Hooper Woolsey, Consultant

2. Concerns

Variations in user Web configurations

- In terms of using the Web, don't expect the visitors to have a specific setup. Their Web setups will vary. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Rapid obsolescence of technology

- I'm concerned about the obsolescence of any component since we know that things change so much. I don't know how many of these Palm devices I've had. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

Maintaining the infrastructure

- There is the planning for resources to maintain this infrastructure. If you plan to have blinking lights and so forth for five years, you'll need people to maintain that. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Bandwidth capacity and scalability

- There are two concerns related to bandwidth. One is matching the amount of data I want to put onto the device to the actual device (dynamic content adaptation). The other, related issue is because of scalability – the user experience is going to be detracted if the user has to wait. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

Battery life

- I'm just going to say two words: battery life. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories
- The answer is also two words: boogey man. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

Security

- Another word is security. A lot of things are based on open standards. If you have a wireless network and people going through there, you don't want them in other parts of your system. If you're using a Palm you may not be able to prevent other people from seeing what is on your Palm. And if I have a Hewlett-Packard CoolTown development kit on my computer you may not be able to stop me from getting into your system. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

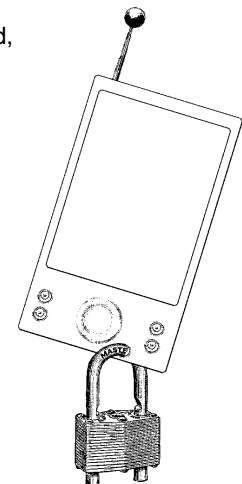
Robustness and ergonomics

- And there are concerns about robustness and ergonomics. • Allison Woodruff, Member of Research Staff, Xerox PARC



Privacy issues

- What about privacy? If we are profiling our visitors, aren't there privacy issues?
- Michael Drennan, Technology Developer, The Tech Museum of Innovation



Language - other than English

- Language issues – other than English. • Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

Task specificity - matching the technology to the goal

- I want to put in a plug for task specificity. If you look at what works – audio guides, for example – we may not like everything about them but they do work. They use the metaphors we live by now and they become appliances for their various processes. If we start with a general-purpose computing device, we tend to think about how there is a lot of stuff we can do with it. It goes back to audience goals and what we were calling “horizontal” versus “vertical” development – what a device is designed for. A system with lots of different functions may confuse people unnecessarily. • Paul Aoki, Member of Research Staff, Xerox PARC

3. Unanswered Questions

Content development

- The question of how we develop content is also a technology and infrastructure question. • Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

Interoperability - across devices and across museums

- There is also the question of interoperability. If I have a customized device for someone with vision problems, I don't want to pick up a new device and have to reformat it each time. How can we make this interoperable, particularly if I want to compare them across museums. For example, I might want to compare the Van Goghs in three different places. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories

Scalability and Capacity

- How can you have people using lots of networks simultaneously? It's a question of scalability and capacity. What happens when a lot of people use it all at once? • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Is the location finding technology worth the result?

- In talking about using bar codes for finding out where you are, there could be a research or evaluation benefit, but is the infrastructure worth it in terms of the visitor – to say “You are standing in front of this exhibit.” Or can we trust the visitor to know that they're standing in front of that exhibit? • Kristina Hooper Woolsey, Consultant

Single or multiple users and adapting to the needs of specific museums

- We didn't talk about whether this is for one person or for several people and also about devices for different types of space. For example, a device for an art museum where they wouldn't want you pointing at a painting with a sharp object and they wouldn't want you getting close to the artwork. • Margaret Pezalla-Granlund, Museum Consultant

Fixing what breaks

- Can we fix it if it breaks? • Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

Networking across museums

- We haven't talked a lot about networks or about connecting institutions. We're focused on use of the device within our space, but connections are also interesting to grapple with. • Rob Semper, Executive Associate Director, Exploratorium

A structure for managing input from visitors

- Can we create a structure for managing input from all of our visitors? • Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

Relationship between device and infrastructure

- What is the relationship of the device and the network? • Rob Semper, Executive Associate Director, Exploratorium

Devices that stimulate social interaction

- The work on the devices as part of the social process is exciting and the work related to that problem (e.g., whether one earpiece or two) is promising. • Kristina Hooper Woolsey, Consultant



Overlapping Issues From Other Categories

- Portability & flexibility of content a plus
 - What works best: text, audio, or video?

Avoiding technoisation

- One concern I have involves social interaction; how to avoid having people walk around with these devices like they do at Experience Music Project in Seattle, with headphones on, heads down – it's terrible. • Andrea Bandelli, Museum Consultant

D. User Interface

1. Promise/Potential

Extending Your Capabilities, Tracking Who You Are

- One of the things shown with the probes is that there are devices that can extend your observational capabilities. Another thing I think is really promising is that you can create your own individual data. Most of us use notebooks. If there were some way to use this technology to keep track of what we've learned, to build data about who we are . . . • Kristina Hooper Woolsey, Consultant

Increasing interactivity with exhibits and information

- There is promise in things like Quicktime VR. There are good reasons why you can't touch objects or draw on paintings in an art museum. These devices can let you do that in the virtual realm. What if this painting was blue? You can try it and see. • Kristina Hooper Woolsey, Consultant

Live Content

- There is the notion of live content, in terms of having a live guide on hand. One thing that we did [at Port Discovery] because our device had messaging capabilities, was to send out live messages from the staff. It's an interesting tool to use, and it allows you to build capabilities on the fly. • Daniel Molitor, Consultant

2. Concerns

Enabling visitor input to the information base

- We need to build an active role for visitors. These devices give the visitors information. But here's very little opportunity for the visitors to give back information and as a visitor I have information to give. Otherwise, it puts me in a passive role. We need the visitors to contribute their own knowledge. In Amsterdam they had a system, not using handhelds but with computers on the floor, that had information from visitors, content you couldn't imagine. Visitors can build an amazing knowledge base. • Andrea Bandelli, Museum Consultant

Making the technology transparent and easy to use

- Another concern is how to make the technology transparent. It's strange to walk around a museum with these objects in your hands. How do we make them transparent and easy to use? • Andrea Bandelli, Museum Consultant

Technology interfering with experience

- What concerns me is the evil side of what I said about the potential for enhancing the audience experience; concern about technology getting in the way of the moment, interfering. • Daniel Molitor, Consultant

Barriers posed by the digital divide

- Obviously the issue of technology as a distraction is a big one. Another is systems that aren't user friendly. And there is the digital divide. If you are

technologically savvy you get lots of rich information, but if you're not technologically savvy you don't. • Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories

Exclusivity of credit card security

- I'm concerned about the exclusivity of having to leave a credit card to check out the handheld equipment. That's why I want a magic bracelet – something that can detect wherever you are but is cheap. There should also be some incentive for putting it back in a return bin – for example, you get access to your own Web site if you do. • Rachel Hellenga, Director of Exhibits, The Tech Museum of Innovation

Confusion between device, design, concept, content

- A concern I have is that of confusing the devices with the general problem. You need some kind of general theory. In the old MIT Media Lab days we talked about a movie of the world versus the real world. You need to think about that. • Kristina Hooper Woolsey, Consultant
- For ideal design you need a general theory of the problem. It has to do with maps and territories – what are the schema you use to deal with the data? • Rob Semper, Executive Associate Director, Exploratorium
- And you need to think about the appropriate use of technology. If you need good recognition and a large screen, don't use a handheld device. Given the maze of technologies, which one should you be using? • Kristina Hooper Woolsey, Consultant
- It was interesting in the SFMOMA presentation, seeing people going around with an iPAQ and standing in front of a huge canvas while looking down at this tiny person on the screen talking about the canvas. It was very strange. There is something about all of these dimensions that is very intriguing. • Rob Semper, Executive Associate Director, Exploratorium

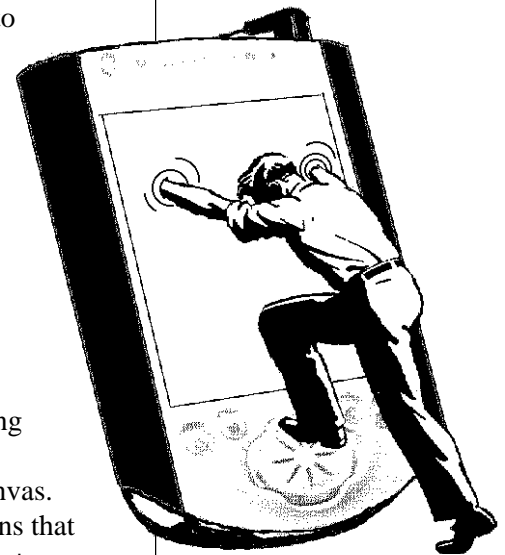
3. Unanswered Questions

Different applications for different settings or one intuitive approach that works for all?

- One thing that concerns me is versatility. The SFMOMA device was really easy to use, and I loved playing with the Concord Consortium probe. I felt like I was really doing science, but the interface felt like a scientific paper. Is there one way that is intuitive for all visitors or will we struggle with different applications for different settings? Is there a universal, intuitive approach? • Melissa Alexander, Project Director, Origins, Exploratorium
- Since the idea of an intuitive design for the general population came up, I'm going to put out that it's not clear there is an intuitive basis for design, because our intuition is based on our experiences. When we visited and saw the CoolTown/Exploratorium demo, we had a curator who just got a computer and it wasn't at all clear to the curator that you click on things – something that would be clear to a computer user. • Jim Thornton, Member of Research Staff, Xerox PARC

Display quality

- Display quality, so you can see outside in different, and difficult, lighting conditions. • Allison Woodruff, Member of Research Staff, Xerox PARC

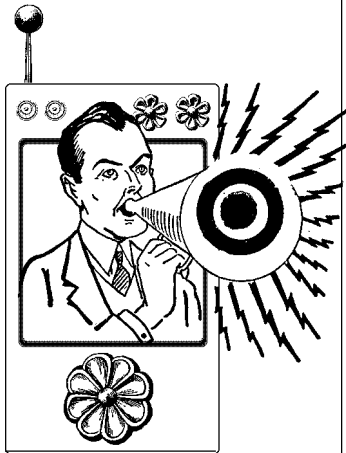


Age and gender needs

- I also wonder how age and gender fit into the question of whether you can develop one universal intuitive approach. • Melissa Alexander, Project Director, Origins, Exploratorium

Ubiquitous computing or highly mediated?

- Are we talking about ubiquitous computing or highly mediated experiences? • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation



A uniform user interface for different systems?

- The stuff we're doing can be represented not just on a handheld device, but on larger systems too. How do you design a user interface for different systems? • Stephen Bannasch, Director of Technology, Concord Consortium
- And specifically for a handheld system versus a system with a full screen. • Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

Voice or personality of the content

- There is the question of voice or personality of the content. Will it be the omniscient voice of the museum or will it be something more personal. I find the idea of using an owl as a device character fascinating [see *Related Projects and Information section of this document*]. We did some that were generic and at other times used characters. It is a question of how it affects the information, which is an issue for museums in general. • Daniel Molitor, Consultant

Overlapping Issues From Other Categories

- Need a user interface that allows for visitor as content developer - visitor input to content and information base.
- Can we use this technology to develop tailored, personalized content for visitors?
- Can we use this technology as an ongoing log to develop data about what we've learned and who we are?
- Are we confusing design of the device with design of content. What is our overall schema? What is the relationship between the technology and the content?
- Whose passions, interests, needs drive the development process? Is it staff-driven development or audience-driven development?

E. Content Development

1. Promise/Potential

Potential for flexibility in content

- There is the potential of flexibility. If we use open standards, by pulling up Web pages you can use content that's there or use new content. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Developing customized content for the moment (and beyond)

- Regarding customization of content, it's also what people want at a particular moment. • Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art
- Can it also be customized content for different times? • Melissa Alexander, Project Director, Origins, Exploratorium

Designing in the space between the real and the virtual

- The Electronic Guidebook presentation showed a chart of a visitor moving between the physical and the virtual world and the ways we interact between those two. Because the devices connect these two worlds, it gives us a way to design in that space. • Kristina Hooper Woolsey, Consultant
- We don't understand what happens in that space. There is a mental shift in your head when you are navigating between the virtual and the physical. • Rob Semper, Executive Associate Director, Exploratorium

Information you can't get from a museum catalog

- I think the Louise Bourgeois video used in the SFMOMA project was amazing, watching her crawling around her studio as she comes to the conclusion about spiders and her mother. That's not what you'd get from a didactic brochure. • Margaret Pezalla-Granlund, Museum Consultant

Tailored experience, repeat visits and building on previous experience

- I would like to read this quote from the Experimentarium, Denmark (<http://www.experimentarium.dk/uk/pressecenter/pressemeddelelser/sonofon.html>):

The idea behind the new service is to take SMS seriously. Our goal is to give each individual Experimentarium visitor an experience that is adapted to his or her personal interests. The Experimentarium is to be a kind of personal servant to the visitor, suggesting various activities and reminding the visitor of displays and activities experienced during previous visits. The long-term perspective is to offer intelligent exhibitions where visitors can recall and reuse previous experience. The 'Future Body' exhibition was the first step in this direction. - Project Manager Mads Hammerich of the Experimentarium.

There is also the idea of reminding people to come back for repeat visits through their mobile phones. • Andrea Bandelli, Museum Consultant

Diverse spatial experience and connections via virtual and real

- There were two things that were interesting from the Port Discovery, Blackberry pager presentation. One was the diverse spatial experience with people in different rooms. Then there was the idea of people working on the handheld and in real space, and the connection that occurs because of working with both. Developing content for these two would be interesting.
- Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

Interactive material on the space between the virtual and the real

- There should be development on interactive material between the content and the activity, on the environment that pushes back and forth between the two. • Kristina Hooper Woolsey, Consultant

Commercial potential for link to museum sales

- This is a mercenary idea that no one has mentioned – that of going around to exhibits you like and finding out about things that are related to the exhibit that you can buy at home. For example, something I could build at home. Here at the Exploratorium you have the *Snackbooks* that people can buy. • Stephen Bannasch, Director of Technology, Concord Consortium

2. Concerns

Information versus process skills

- There is a difference between conveying information and process skills. It's not just information on plate tectonics, but the context for integrating that information that we pride ourselves on at our museum. • Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston

A base for further learning

- I'd like to throw in an idea. Within these devices you could use the exhibit as a base for more formal learning, or it could be self-taught learning. • Rob Semper, Executive Associate Director, Exploratorium
- Or for people who work with teachers – you could do a project and then come to the museum to continue the project. • Stephen Bannasch, Director of Technology, Concord Consortium



Age, Different Abilities, Language

- You could just copy the concerns expressed in other categories concerning age, ADA, and language. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories



Who is developing content - exhibit developers or software people?

- I have a question related to the recent wave of Web sites in the museum field. Who is developing these things? Probably not an exhibit developer. Is it a Web site designer? This relates to who is creating these things. • Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

Need for software exhibit developers can use

- I think it's also about having the technology with software. If it's there then the exhibit designer can do it. It made a huge difference to us to be able to do it ourselves rather than farm it out. • Daniel Molitor, Consultant

Visitor involvement in inputting and processing information

- I'd like to extend that idea of process further. For people doing more involved work, I think in terms of their ability to do projects or research; to be able to keep track, organize, use this as something of value. I want kids to be able to tell stories about what they've done (and stories turn into research papers). It is a matter of making sure that the idea of content isn't just what the museum develops. It may be as simple as user-added data. For example, there's an exhibit upstairs here at the Exploratorium that measures hearing. I wanted to be able to enter my age, see scatter data relating to how my hearing compared to those older than me and those younger than me. • Stephen Bannasch, Director of Technology, Concord Consortium

Maintaining content with idiosyncratic charm

- Here at the Exploratorium, I was talking to Natalie about the idiosyncratic information you have about people who developed exhibits or use the exhibits. I wonder how you get to do a project that is idiosyncratic and playful in a museum with limited staff and time when so many high expectations are riding on it? • Margaret Pezalla-Granlund, Museum Consultant
- We have a real question about moving beyond the research project to implementing this in the field in a systematized way. • Rob Semper, Executive Associate Director, Exploratorium
- This is a matter of the developers making sure that the tools we're developing have the capability of expressing idiosyncratic stuff. In the kind of work I do, designing an exhibit with this in mind, I would be designing with a handheld device in mind. From the art museum perspective, people like to hear the artist talking about his or her work. What if the artist was involved in designing the handheld interaction? • Stephen Bannasch, Director of Technology, Concord Consortium

Separation/communication between visitor content and research content

- There is the danger of two content streams – general visitor content versus research content. Since it is directed at two different audiences it's likely done by two different sets of people: research content by researchers, and visitor content by curators or exhibit designers. Make sure that the two groups talk to each other. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories

Maintaining, upgrading, renewing content

- In discussing the technology infrastructure we noted that there is maintenance and cost down the line. That is similar in content as museums move exhibits, create new exhibits, and so forth. • Jim Thornton, Member of Research Staff, Xerox PARC
- That also has to do with timeliness. For example, for science museums or medicine, content like Web sites goes stale. It impacts on the relevance to visitors. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

3. Unanswered Questions

Choosing content and format (text, video, audio)

- I have some content questions and concerns before the next phase of the Electronic Guidebook. I wonder how others working with handhelds chose the stories you did; how you chose the content. And I also have questions about the format. Has there been any testing or exploring of sound versus text versus video? • Katherina Audley, Content Developer, Electronic Guidebook Project, Exploratorium

Layer on top of old exhibits or start from scratch?

- Can this be successfully layered on top of existing exhibits and experiences or do you have to design for this starting at the beginning of new exhibits? Should you do it only with new stuff working forward, or can you do it for the 280 exhibits you already have on the floor? That question is applicable to a wide range of other channels, including how you approach floor activities and educational activities. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Shaping new knowledge or conserving old knowledge?

- I was wondering about the same question at four this morning. Is this a tool for innovation of knowledge, for changing and shaping knowledge, or for the conservation of already acquired knowledge? After listening to the various projects, some fit into one category and some in another. • Melissa Alexander, Project Director, Origins, Exploratorium

What information - how do we select the interesting & engaging?

- All of my comments are about information and about cylinder seals – an ancient device for imprinting a seal using inscribed cylinders that are one to two inches long. In my last job I found that even though there was this big catalogue about cylinder seals most of the information was not interesting in any way. My job was to pull out interesting or engaging information. My point is that there is a lot of information out there. What is it we want to be using? • Margaret Pezalla-Granlund, Museum Consultant

Relation to standards and benchmarks

- Museums are under increasingly more pressure to align what they are doing with state standards, benchmarks, and so forth. How do handhelds tie in with standards and benchmarks and state curriculum issues? I think some interesting things could be done. • Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston
- Mike Petrich brought up the question earlier about who drives the development. That question should also be under content, especially if we're talking about standards. • Margaret Pezalla-Granlund, Museum Consultant

Depth and nature of content - mediated, new, repackaged

- To what level of thought can we go with the content? For example, do we include complicated scientific papers? A second question is how much do we need to mediate the content? How much original material will there be, how much mediated, and how much repackaged? • Andrea Bandelli, Museum Consultant

Capacity for Creating New Content, Scavenging Old Content

- One question I'm worried about is how we are going to create this content – from a language standpoint, let alone anything else. A lot of museums I go to haven't touched the exhibit labels in fifteen or twenty years. Also, is there a way to scavenge content that already exists? Can we at least get existing content out? The question is how to create content. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research

What is the previsit?

- An unanswered question I have is what would a previsit look like? • Rachel Hellenga, Director of Exhibits, The Tech Museum of Innovation

Copyrights and ownership of intellectual property

- How will we deal with the issues of intellectual property, copyright, usage? • Daniel Molitor, Consultant

Sharing content and communication between institutions

- My copyright question is related to another question about sharing of content. If there are multiple institutions doing this around town, can they talk to each other? • Daniel Molitor, Consultant

F. Staff and Operational Issues

1. Concerns

The range of skills needed by developers

- There is a range of skills needed by the developers (Flash, programming, HTML, etc.). This relates to another comment about some technology only working well on certain screen sizes. Obviously you want those who are doing the development to have as wide a range of skills as possible. • Eamonn O'Brien Strain, Research Scientist, Hewlett-Packard Research Laboratories
- You want to write the material once, but want to be able to read it on any device. You have to figure that out before you embark on it.. • Ron Hipschman, Senior Media Specialist, Webmaster, Exploratorium

Security issues when taking visitor credit cards

- We found that when visitors were checking out devices we were concerned about the potential for staff manning that station taking down visitor credit card information when there was a computer right there. • Daniel Molitor, Consultant

Adequate staffing, commitment, and team work

- I have a concern that has to do with building teams and taking responsibility for achieving goals. A colleague and I came up with the formula: 10% of 10 staff members' time = 0% FTE. The point is that the project will not move forward if people have a ten percent stake in the project. They need at least fifty percent or more. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Staff training

- The staff will need to be trained as well. • Anon

Device distribution on floor and front line staff overload

- Who is responsible for maintaining distribution of these devices to visitors, collecting the devices afterwards, etc.? People will say, "Wait a minute, the front line staff is already overloaded." This is time consuming and will need to involve more than the traditional front line staff. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation



Equipment & technology maintenance

- Who is going to maintain this? What happens when a device is dropped? • Melissa Alexander, Project Director, Origins, Exploratorium
- There's the issue of having equipment to replace the equipment as it goes down, having spares, and the ability to clean the equipment. • Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

2. Unanswered Questions

Impact on docents

- In our museum we have been a heavily docent-led museum. I wonder how this changes the role of the docent and whether the visitor has options concerning using a docent or a handheld device. Also, does it interfere with the docents if they are trying to lead a tour and people with handheld devices come up? • Tom Steller, Chief Curator, Natural Sciences, Oakland Museum
- I think it's also an opportunity – we shouldn't always see it as competing with docents. This could be a conversation provoker that gets you speaking to docents. • Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium
- We have sixty-five interpreters in a program I work with. We hope to use the model of docents using handhelds with visitors. • Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston

Visitor paths through space and the multiple roles of docents

- I have some issues that have to do with staffing. In different museums there are different ways that people go through the museums. Here it's very random, you may want an interface by the exhibit. In others there could be a path, or you have very big spaces, like the Louvre. How do visitors float through space and what role do docents play? In some museums they double as security guards. What were docents doing besides providing content? And what about crowd control issues? • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories

Protocols for collaboration with research institutions

- These types of projects often involve collaboration with research institutions. How do we operate in that mode? • Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium
- Is there a business model? My point is whether there are business models, in audio guides for example, that would make sense here – models for developing in partnership rather than in-house. • Jim Thornton, Member of Research Staff, Xerox PARC

Integration with the institution's network & operations

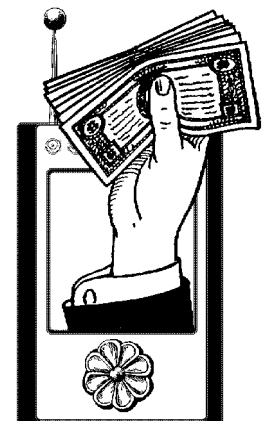
- In addition to maintenance there's the question of how to integrate this into the network of the institution. • Ron Hipschman, Senior Media Specialist, Webmaster Exploratorium
- Are there opportunities to integrate this with ticketing and the call center? • Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago
- There could also be integration with the museum store, which doesn't have to go to the Disney level. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories

Marketing opportunities relating to branding or business model?

- Are there marketing opportunities related to branding? Things that could affect the business model? • Daniel Molitor, Consultant

Can this be used to increase staff communication?

- Can it be used internally to increase communication among staff members, especially between floor staff and office staff? • Andrea Bandelli, Museum Consultant



How do you make this a permanent a permanent part of your budget?

- There's special budgeting the first time you do a project like this, but how do you make it a permanent part of your budget? • Margaret Pezalla-Granlund, Museum Consultant
- And how do you fund evaluation as well? • Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

The human life of institutions

- How does this relate to the human life of institutions? • Anon

Who is responsible for updating as exhibits change?

- The idea came up earlier that exhibits move or are taken off the floor. You could create a networked data base that helps everyone in the museum know the status and locations of exhibits. • Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

Overlapping Issues From Other Categories

- What works best: text, audio, or video?
 - Does this isolate the visitor?
 - Does this enhance the visitor experience?
 - How do gender, age, economic class of the audience affect the experience?
- Does this help address the digital divide or does the digital divide have a negative impact on audience ability to benefit from the experience?
- What happens in the mental shift between the virtual and the physical?

G. Research and Evaluation (Visitor Studies)

1. Promise/Potential

Gathering and using visitor information

- I see museums as an environment with hundreds of people coming through and we never have any idea what information they have to offer or what their opinions are. These electronic guides offer a way to gather information and feedback that can be used for rating exhibits and for making associations between exhibits. • Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories

2. Concerns

Visitor privacy and ethical issues regarding data collection

- Though these systems can collect a lot of data about user movement and so forth, what data should you collect and is it ethical? Even if you don't share the data with anybody else, you've got it. • Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago
- There is the issue of privacy which relates to industry standards and individual comfort level. • Rachel Hellenga, Director of Exhibits, The Tech Museum of Innovation

3. Research & Evaluation Methods, Approaches

Accessing the data

- How do you get access to the data that exists? • Anon

Building on, feed back into, the existing knowledge and research base

- I hope you look hard at how to develop research tools that build on what is already being researched; that you build on or link to what is already known or has already been researched about nonnomadic visitor experience. How can we build on visitor experience in informal learning environments and feed back into that knowledge base so that we are improving practice and building knowledge all around? • Kathleen McLean, Director, Center for Public Exhibition, Exploratorium

Using online marketing research techniques

- Not much is known about user research of online materials but online market-

ers have data on everything from who is using it to demographics. So one idea would be using marketing research techniques to understand audience use of materials. • Rob Semper, Executive Associate Director, Exploratorium

Feeding into exhibit design

- A lot of this would be useful in exhibit design. • Stephen Bannasch, Director of Technology, Concord Consortium

Developing a language for the research

- I keep thinking about case studies. We seem to be very much in the mode of “Does this situation work?” As this matures we’ll see categories of intentions and categories of place. At this point we don’t have much language for this, we’re pretty primitive. • Kristina Hooper Woolsey, Consultant
- We’re in the process of developing the taxonomy, of seeing the patterns. • Rob Semper, Executive Associate Director, Exploratorium

Research methods for fields that haven’t existed before

- There is an existing field of research and evaluation. I’m curious whether there are existing techniques that provide methodologies for fields that haven’t really existed before. • Doug Conaway, Resource Development Director, Center for Media Communication, Exploratorium

4. Research/Evaluation Questions

Does this stimulate understanding and inquiry?

- I have an evaluation question – to what extent does this stimulate understanding? To what extent does it stimulate inquiry? • Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston

Does it enhance retention?

- I would like to know if using this technology enhances retention of experience or knowledge after they leave the museum. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

The validity of the previsit experience?

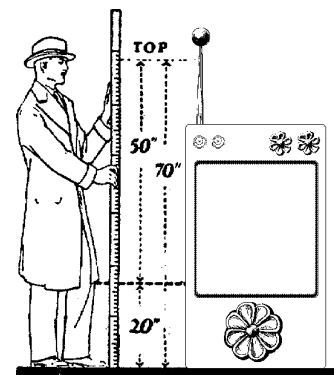
- That would also be a research topic – the validity of the previsit experience, or do you want the experience to be experienced cold when visitors walk in the door? • Daniel Molitor, Consultant

What are the indicators of success regarding visitor experience?

- Everyone here wants to deepen and extend visitor experience with the exhibits using the gadget. But does extended time at an exhibit necessarily indicate a deeper level of interaction? It is possible that visitors might spend more time at an exhibit using the gadget but their time may have been spent dealing with technical difficulties and what they remember primarily of their museum experience could be the difficulty they had with the technology. • Katherina Audley, Content Developer, Electronic Guidebook Project, Exploratorium

Capturing data before you know the research questions

- I have a concern about capturing data. We start designing these systems without knowing what the research questions are, so you need to make sure that you capture enough data to recreate the situation. • Mirjana Spasojevic, Project Manager, CoolTown Program, Hewlett-Packard Research Laboratories



What impact will data collected about visitors have on the museum ?

- How does the knowledge about the people who come to the museum and how they move about the museum influence the museum itself and the way the museum is organized? • Marcos Frid, Research Engineer, Hewlett-Packard Research Labor

Usability issues

- There are also usability issues • Paul Aoki, Member of Research Staff, Xerox PARC



How much can users contribute to content?

- I think it's important to look at the contribution of users and ask what you can expect from them. Learning how to input is not easy. • Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories

Classes of users

- There are a lot of classes of users: students, teachers, walk-ins. We need to think in terms of different classes and how they use this in different ways, both pre- and post-visit. • Ron Hipschman, Senior Media Specialist, Webmaster, Exploratorium

Portable versus fixed

- In terms of different modes, my sense is that there is a lot of research on the use of video, audio, and text in fixed installations. The lessons will be different for a handheld because it's portable. • Paul Aoki, Member of Research Staff, Xerox PARC

How does personalizing or customizing for visitors affect their behavior and the exhibit design?

- A second class of things I think is interesting is how personalization and customization affect various aspects of the experience. For example, if you learn about basket weaving while I learn about paintings, we might share afterward or not. If we learn the same things, the experience is less personal but we might be more likely to talk about it. • Paul Aoki, Member of Research Staff, Xerox PARC

Research on visitor privacy and personalization preferences

- What aspect of personalization or privacy do you find most valuable? We could arrange the information in different ways (e.g., based on color, the path they took, etc.). Which do they care about? Do we even need to know their name? • Craig Rosa, Director of Information Technology, The Tech Museum

Brand extension

- Can this be of use to the museum in brand extension? • Rob Semper, Executive Associate Director, Exploratorium

Gender issues

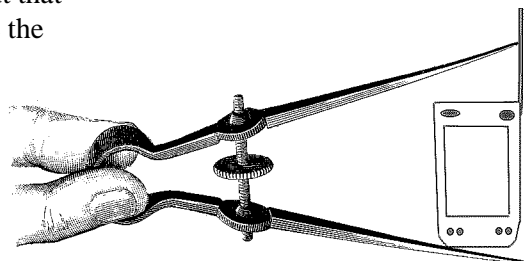
- A project that Hewlett-Packard did in Bristol showed that use of handheld computers had a positive impact on the way girls approach science. The contact name for the research project is Priscilla Heard. • Andrea Bandelli, Museum Consultant

Walk-in versus repeat versus oriented visitors

- I'd be interested to find out the difference between a walk-in visitor with his or her own handheld and a visitor who received an orientation using special programs. And also walk-in versus repeat visitors. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Scalability questions

- We need to get a better understanding of scalability issues, preferably before the giant roll-out. If you are planning a big show, like the great panda or the Mona Lisa, we know about that beforehand so we can manage the increase in visitors. But we need to do explicit scalability tests because we don't know what's going to jam. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories



V. LESSONS LEARNED & NEXT STEPS

- Rob Semper, Executive Associate Director, Exploratorium

We have had some success yesterday in laying out the landscape and in getting the group psyche. It struck me that although we are from different walks of life we are all grappling with the same issues. However, the goal of this forum is to emerge with documentation that serves as a report to the field at large, and we have not yet discussed how to prioritize the things that surfaced yesterday.

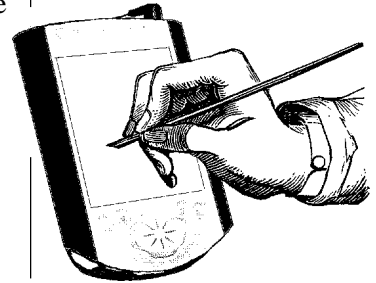
Today we will try to get our hands around lessons learned, what surprised us, and what we see as the next steps in development. We will do that by working in small groups in an attempt to keep the discussion focussed. Each group will generate a list of recommendations. The first set of recommendations will be based on lessons learned. Some of you have expressed an interest in hearing the horror stories from those who have already tested or implemented electronic guides. Our hope is that those horror stories will be translated into lessons learned.

The second set of recommendations will focus on next steps: new studies, points of research, things we don't know, things to be learned. We will then regroup as a whole, hear the reports from the smaller groups, and have the chance to compare notes and discuss the ideas that emerged.

The Task

Working in small groups, generate a list of recommendations regarding:

1. Lessons learned,
2. Next steps.



A. Group One

1. Lessons Learned

Rules of Design

In all of this, the basic rules of design apply: start at the beginning, look at the environment, focus on the use of the device within the space. Start with a prototype and content and the interaction between the prototype and the content. • Rakhi Rajani

Lessons

- Rules of design apply
- Select a minimal set of features and activities
 - Focus is not on the device
 - Device affords user activity
 - Avoid "feature creep"
- Make sure mobile device is what you need
 - Consider the alternatives
 - Benefit to user must outweigh the cost (inconvenience, need to interface, possible limit to social interaction, etc.)

Some people in the group said, "Of course the basic rules of design apply." But I think some museums are not familiar with literature on Human-Computer Interface design. • Natalie Rusk

A Minimal Set of Features & Activities

It's important to select a minimal set of features you're going to address; make it good at a few things. This brings up CoolTown because they made a device for a lot of different things and are now focusing in on one: "remember."

Group Members

- Paul Aoki, Member of Research Staff, Xerox PARC
- Andrea Bandelli, Museum Consultant
- Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories
- Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories
- Rakhi Rajani, Researcher, Hewlett-Packard Research Laboratories
- Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium
- Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

Is A Mobile Device What You Need?

Make sure a mobile device is what you need. People were saying earlier that you need to measure the benefit versus the cost. Is this really what you need? There could be other ways to do it. • Natalie Rusk

Next Steps

- Increase social interaction
 - Use handhelds as catalyzers for face-to-face interaction
 - What are ways to do this?
- Encourage visitor feedback, reflections, responses, knowledge. Explore:
 - How this works?
 - What motivates contribution?
 - How much will they?
 - When?
 - In what forms?
- Work to make it easy for other museums to learn about what's been done and how they can do it themselves.

The focus should not be on the device but on user tasks. The purpose of the device is to afford user activity. And finally, avoid feature creep. For example, because it comes with e-mail and a browser it's tempting to exploit these but it confuses the user. • Paul Aoki

2. Next Steps

Increase Social Interaction

This could be done with programming, or at some point visitors could put the devices away and connect with each other. The handheld could help increase social interaction. We know that people come to museums to be in a social environment. • Andrea Bandelli

Encourage Visitor Feedback, Reflections, Responses, Knowledge

There are ways that a handheld can help a visitor reflect back, be a constructor, a maker, a responder, not just a rememberer. We need to explore how this works and what that might mean. • Susie Wise

Making It Easy For Other Museums To Do It

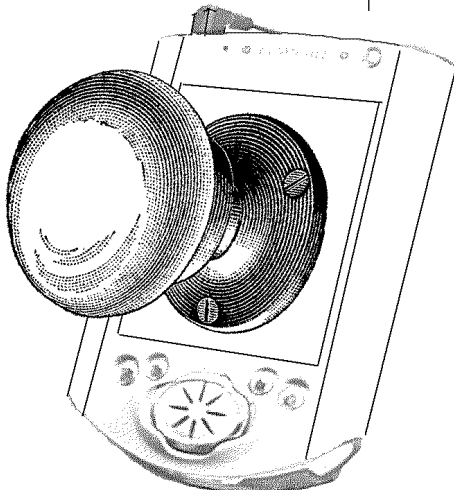
Our final point is to make this technology available. We've heard about customizing for different situations. At CoolTown we are talking about making a starter kit. People will come up with their own custom solutions but you can't expect everybody to start from scratch.

Also, if we have a starter kit we can get other museums to start their own pilots which will lead to a bigger community that can interact virtually, through a Web site. On the Web site you can check out source code and put in your version of it. • Marcos Frid

3. Questions, Comments, Ideas

Starter Kit, Web Site For Other Museums

- Is this something your group was talking about or is this something that Hewlett-Packard is talking about? • Melissa Alexander, Project Director, Origins, Exploratorium
- It's something my boss told me to do. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories
- We're also talking about resources, a place where people can talk about lessons learned – like this meeting, but in a broader forum. • Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories
- So building a community of knowledgeable developers and users? • Rob Semper, Executive Associate Director, Exploratorium
- And bringing other museums up to speed. I think if museums can find out what others are using they'll learn more, faster. • Jenna Burrell,



4. Overheard In Group One - Background Discussion

Visitor Feedback (Thoughts and Reflections)

- There is something that requires more understanding and research – the question of where people want to contribute or feed in. That's different than social interaction. We did originally have an idea where you could see what another visitor is looking at or working on so someone else could come up and interact. • Susie Wise
- Are you talking about feedback that others could benefit from or ways to improve the system? • Jenna Burrell
- You're saying it's their ideas, not so much, "Is it a good exhibit?" • Natalie Rusk
- One thing a museum can be is a place for thinking and reflection and this is a way to encourage that. • Susie Wise
- And otherwise where does that thinking and reflection go? It's in their heads. • Jenna Burrell
- The question is how that would work. • Natalie Rusk
- When will they contribute, and in what forms? • Jenna Burrell

Increasing The Community of Museums Doing This

- One thing I'm working on is a starter kit for museums so that the number of people familiar with using this technology will increase. We have a site for Web developers and one part is for CoolTown ideas, and Mirjana asked me to put together a starter kit for museums. I want to do it on different levels. The first can be super simple. This becomes Web pages and the code is there and works on the Palm, on laptops, on whatever. And when we work on "remember" technology we can put that on there as well. You could make it more general and make the tools and the technology available to other institutions. • Marcos Frid
- What do you think is entailed in that? It's not just the technology, it's also lessons learned. • Susie Wise
- You could have a place where you have links to reports to find out what other users are doing. But from my point of view, you want something quick – so the tools are there and you can use it. • Marcos Frid
- Maybe you want a community to share tools, interests, etc. • Paul Aoki
- This could grow into a monster Web site where all these museums have different questions. It could carry on what's happening here, at this forum. • Marcos Frid
- But only if they have decided this is what they really want to try. • Natalie Rusk
- So one thing is to make sure we share the lessons learned. • Jenna Burrell

Group One - Butcher Paper Background Notes

- Focus on explicit tasks
 - Importance of knowing what they are
 - Example = social interaction
 - give info
 - promote social interaction
- only tapping
- not complicated
- minimal explanation
- experience not about device
- Why using this medium?
- Visitor benefit has to be worth the "cost"
- need motivation to create personal content
- join a community, not burden of starting community
- benefits:
 - leave happier, enhanced
 - engagement
 - "voices" of the place
- cost:
 - physical discomfort
 - learn new system, interface
 - risk to initiate participation
- physical context: standing vs. sitting, space in environment

benefit	cost
engagement	limited social experience
voices you wouldn't otherwise hear	physical inconvenience
richer experience	work w/in context
more info(?)	learn new system
additional media	
different modalities	

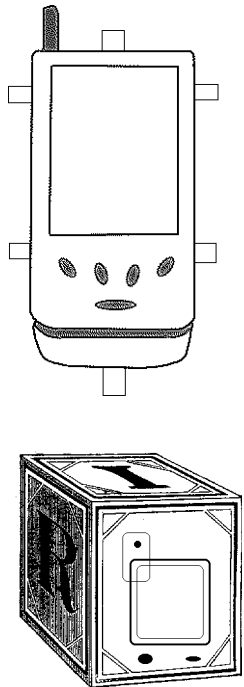
B. Group Two

1. Lessons Learned

We had representatives from two deployed projects and two research projects so there was no shortage of lessons learned.

Group Members

- Katherina Audley, Content Developer, Electronic Guidebook Project, Exploratorium
- Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art
- Daniel Molitor, Consultant
- Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston
- Mirjana Spasojevic, Project Manager, CoolTown Program, Hewlett-Packard Research Laboratories
- Allison Woodruff, Member of Research Staff, Xerox PARC (Mirjana Spasojevic reported results to the full group)



Goals

- Be clear, be realistic
- Time, resources, audience
- Management buy-in, intellectual property issues

Our first lesson involves goals and how much work one has to do setting goals and expectations, and how realistic you have to be. The tendency is to be enthusiastic and to oversell.

Make sure you have management buy-in. One side note was about intellectual property issues – this has to be a multitrust project.

Then it's down to implementation, though our questions concerning the team also have to do with setting the scope. Make sure you have a team that includes all of the necessary skills. That has to include someone with the ability to make decisions for the team and the project. Communication is key because with team members from different institutions and different disciplines, if you don't communicate there can be chaos. So you need a disciplined team, but at the same time you need to allow for freedom and creativity. You also need to know your key stakeholders (e.g., maintenance, visitor services, etc.).

Team

- UI Designer/Graphic Designer
- Content Developer
- Museum Educator
- Exhibit Developer
- Visitor Advocate
- Participant Designer
- Program Manager/Decision Maker

communicate!

Prototypes

- Paper Prototypes/Low Fidelity Prototypes
- Prototype Activities
- Prototype Technology
- Test Very Simple Things First

(Demo vs. Prototype)

Our third set of lessons is around prototypes, starting with the idea of using a paper description instead of a full blown prototype. Then there is the idea of testing prototype activities before prototype technology. In our case [Electronic Guidebook] we did a demonstration. We want to make it clear that a demonstration is different than a prototype. You can use prototypes in a variety of ways, and you can use low fidelity prototypes. For example, if you plan on using a Palm, you can use a wooden block as a stand-in

during early prototype testing. With early testing in general, you can work in spiral development, starting with a semi-working prototype.

2. Next Steps/Questions/Projects

Here we were all over the map. We tried to boil it down to three recommendations and didn't quite succeed, so we ended with four.

First, evaluate and test the choices for content delivery and find out what works for different domains. Different museums have different environments, which feeds into choices regarding content.

Evaluate/Test Choices for Content Delivery

- Text, audio, video . . .
- How it depends on the domain

Evaluation

- Visitor Experience
- How to Measure (quality, quantity)
- Real World Trends (technological sophistication of visitors)
- Surveys, Interviews (use existing)

On the top level there is the question of visitor experience. How do you capture, measure, quantify, express differences in quality? We would like a handle on these questions.

If you are talking about an informal situation, it happens over time. How do you know if the flavor of the individual

experience will motivate someone to be a science teacher years later? How do we measure that?

And how do you correlate the technological sophistication of the user? We have all heard how technologically savvy teens are. What do we know about that and how much does it apply here?

Then we thought about in-depth, specific studies focusing on one exhibit or area, and going really in-depth concerning content and questions.

In-Depth Study

- Narrow Scope
- One Exhibit, One Area

Customization, Personalization - What?

- Pre-, Post-Visit Experience
- When, Where, How Deep Content

Finally, one interesting direction that some projects could take might involve customization and personalization. What does that mean? How do you want it to happen? What and where?

Shallow content? In-depth? Will it stretch into the pre- and post-domain?

So these are our general next steps, around which we could write a new proposal or a two-year project. I think personally we could have spent another hour talking about next steps and some of them are very high level versus very specific.

Overheard in Group Two: How Technology Changes the Visitor Experience

- In our project at Filoli there was the story of a couple going through, using the guidebook. His comment was that he was replaced by the guidebook – he was the one who usually answered questions and assumed authority.

Also, there are people who get the paper guidebook and don't use it because they don't like it. They just wander through, which is a very relaxing experience for them. When they get the electronic guidebook it becomes a task. They learn more but it's hard for me to assess whether that's a better activity. • Allison Woodruff

- It's important to recognize how use of these things changes the experience; it's a different activity. • Daniel Molitor

- Characterizing the visitor experience and how it changes are research questions. • Allison Woodruff

- The socialization things, for me, are the most intriguing but you can't use standard evaluation techniques. • Mirjana Spasojevic

- There's also the question in the larger field. There are kids with pagers and now they have two-way pagers. How is that affecting them? There must be some existing study out there about how this is affecting society in general. • Daniel Molitor

- There's a valid argument that if you're in a museum you want an experience different than your every day experience, so if I use a cell phone in daily life I may not want to use it here in a museum. • Mirjana Spasojevic

- There is something that worries me in thinking about how to evaluate this technology. A visitor could be standing in front of a visit waiting for a video to load. You're observing them and you think, "Wow, they're spending a lot of time with that exhibit. They must be having a valuable experience." And what they're really doing is waiting for a video to load. • Katherina Audley

C. Group Three

Lessons Learned

- Keep it simple
 - Don't do wireless unless your network is stable and well documented
 - Don't use "bleeding edge" technology for your deployment application
- Have enough equipment
 - Doing it with minimum equipment makes the project take longer
- Involve all staff that will be impacted
- Put enough resources into content
- Add a strap

Add a Strap

And finally a simple suggestion – add a strap. • Craig Rosa

Group Members

- Melissa Alexander, Project Director, Origins, Exploratorium
- Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago
- Michael Drennan, Technology Developer, The Tech Museum of Innovation
 - Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories
 - Eamonn O'Brien Strain, Research Scientist, Hewlett-Packard Research Laboratories
 - Craig Rosa, Director of Information Technology, The Tech Museum of Innovation
- Tom Steller, Chief Curator, Natural Sciences, Oakland Museum

1. Lessons Learned

Keep It Simple

Our first lesson is keep it simple. Don't do a wireless project unless your existing network is stable and well documented. On the other hand, if your building or space is old, historical, or tricky it could be difficult to get your network to integrate so another alternative is to skip integrating with the existing network and start new.

Don't use bleeding edge technology in the deployment stage. Instead, go back a couple of steps. Visitors won't cut you a lot of slack – they expect it to work. • Craig Rosa

Have Enough Equipment

Also, if you try to do it with less than you need it will be twice as hard. • Melissa Alexander

Yes – doing a wireless project on a shoestring is tricky. • Craig Rosa

Include All Involved Staff

This means involving your front line staff right from the start. • Craig Rosa

Put Enough Resources Into Content

Put enough resources into content. The "medium is the message" only goes so far. • Craig Rosa

Particularly innovative content. • Margaret Fleck

This isn't just a technology project. From what I've heard, the emphasis on developing content is maybe fifty percent of the project. • Craig Rosa

2. Recommendations

Recommend

- Make prototyping part of museum experience
 - Plan for labor intensive user/visitor studies
 - Be very clear about what your objective is and only use the application when it's the most effective
 - Don't use handhelds for things that already work well
- Not up to you Be willing to say something doesn't work

Make Prototyping Part of the Experience

Make prototyping part of the process of innovation, and part of the fun of being at the museum. Be overt about it – for example, give discounted or free admission to visitors who participate in testing the prototype. This also establishes your brand as being an innovative place. • Craig Rosa

Evaluation and Visitor Studies

Plan for extensive evaluation and visitor studies. • Craig Rosa

Match Objectives and Goals to Use of Appropriate Technology

Be clear on your objectives and only use technology when it is called for. For example, a portable DVD player may be better than a wireless device in certain circumstances. Don't use handheld devices for things that already work well as is. If you have a scavenger hunt that works well with clipboards and the kids love it, don't shoehorn a wireless device into that experience. • Craig Rosa

Recognize When It Doesn't Work (Which Is Up to the Visitor)

Be prepared to say that something doesn't work well. And it's not up to you to decide that something doesn't work; it's up to the visitors. • Craig Rosa

3. What We Don't Know

These are some of the things we don't know:

- What the visitor thinks.
- The impact on visitor behavior.
- What device is the best given for any application? We're still not clear on that yet.
- What is the killer application for a wireless handheld device that you wouldn't want to do on a DVD player, with a clipboard, and so forth, and can we focus on that subset? • Craig Rosa

4. Questions, Comments, Ideas

Identifying Killer Applications/Matching Museum Objectives

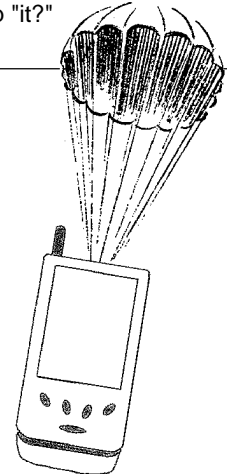
- I'd be curious how people here respond to your last question. We talk about what visitors think; what do we think? What do we think the killer applications are? • Daniel Molitor, Consultant
- You had a good one [at Port Discovery]: kids using a pager to communicate with each other. • Anon.
- But there has to be congruence between what the museum believes it is and what you're providing, so if paging is a long term strategy for connections between exhibits fine. If not, you shouldn't be doing it. The research has to be guided by the museum's choices concerning what it wants to do. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University

Strategies for Coping With "Bleeding Edge" Technology

- I wholeheartedly agree with your comment about choosing technology that is a step or two behind but the problem with the handheld market is that it is moving so fast, if you are two steps behind your device is

What We Do Not Know?

- What the visitor thinks
- Impact on visitor behavior
 - Are we changing their perceptions?
 - Does the device improve their experience?
- What device is best?
- What killer application?
- How far can we drop "it?"



Straps and Fanny Packs

- Make sure the strap fits your audience. It was a huge issue for us. The solution turned out to be a simple off-the-shelf product (a kevlar tether used for camcorders) but it did involve research and testing. • Daniel Molitor, Consultant
- What about a fanny pack? • Allison Woodruff, Member of Research Staff, Xerox PARC
- We found one that fit the device perfectly. • Daniel Molitor, Consultant
- How did you attach the tether to the device? • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories
- Epoxy - that was another real issue. • Daniel Molitor
- I was amazed that there is no form of strap or lock point on any of these. • Margaret Fleck

Overheard in Group Three: Make Sure the Technology Works & Involving Visitors in Prototype Testing

- What about tolerance for exhibits that don't work? I'm thinking in terms of risk and I'm getting a sense that there's more tolerance for risk at the Exploratorium. Is it different at The Tech Museum? • Eamonn O'Brien Strain
- People treat technology like they do their PC – they get frustrated if it doesn't work. • Craig Rosa
- At The Tech we have a very aggressive engineering staff to make sure that there aren't downed exhibits. Our up time is about 98%. If you handed someone a computer at The Tech you would have to go beyond: "Oh wow, I've got a computer." • Michael Drennan
 - When we were testing devices at the Exploratorium people seemed to understand that it was a prototype, and we gave them a cool pen at the end for participating. I think it would have been different if it had been an experience they paid for. • Margaret Fleck
 - One thing I've been thinking about at The Tech is the idea of getting people involved in testing the technology. That way they feel they're part of the innovation and I think they'd find that even better. So giving you feedback would be part of the fun. • Craig Rosa

obsolete and there's no support for it. • Jim Thornton, Member of Research Staff, Xerox PARC

- We were thinking more of software and also of the next range of deployment in museums that are less well staffed. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories
- Maybe the solution is to budget in changing technology over a four to five year project so you could always feed new devices in. For example, you could plan for three swap outs in the life cycle of the project and build that into the cost, knowing that the problem of obsolescence will be there. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation
- There's a secondary market the obsolete devices could feed into, like the one at Stanford that distributes textbooks to third world countries. • Margaret Fleck
- I'm struck by lease terms and the question of how you make the right device-time trade-off so you can move on. • Rob Semper, Executive Associate Director, Exploratorium
- And where is the innovation focused: on hardware, software, design for interaction? The latter will last the longest. This is an enormously important question if you want to have something sustainable. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University
- You can have a system where content is stored in a data base and you hook into it. • Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago
- It's hard to separate the ability to innovate on the software side from the hardware. Right now there are a lot of limitations. • Allison Woodruff, Member of Research Staff, Xerox PARC
- But if you are doing a research project, research is about innovative design and use. I agree that hardware functionalities are configured so it's difficult to pour from one to another. • Larry Friedlander
- But the process should get better. Look at laptops – now any random laptop can do what you want it to do. We're right at the beginning of handheld technology. • Margaret Fleck
- In a few years it could be that people bring their own devices and what we're providing from a network they feed into their own handheld device. • Larry Friedlander
- Is the model going to handing out devices ala audio tours or are we assuming the technology will be ubiquitous enough so that people will have them? • Craig Rosa

A Focus on the Message, Not the Medium

- All this gets back to a basic museum issue which is: what do you want your museum to be doing? It's like the television issue. A television can be the size of your watch, the size of a wall, or whatever; the content makes the difference, and the content creates the identity. The medium is transparent. So we need to be planning for a time when the technology is ubiquitous and unimportant. • Daniel Molitor, Consultant

5. Overheard in Group Three - Background Discussion

Evaluation Issues and Questions

- Part of the prototyping process has to be visitor evaluation, but it's not whether you think it works, it's whether the visitor thinks it works. SFMOMA appears to be doing that and I hope they get valuable information. You have to put in a ton of time. I would think you need a whole evaluation scheme including formative and summative.

Looking at the lists of what we don't know, a lot of that is from the visitor's point of view. Retention came up yesterday, and the idea of how much retention has to do with knowledge. That's something we don't know a lot about. • Tom Steller

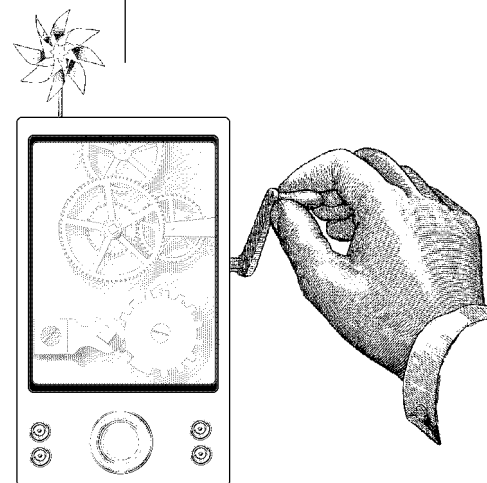
- I would like to see research on the impact this has on people's behavior; the impact on their everyday life, on their viewpoint. • Scott Beveridge
- This is a question museums ask themselves constantly. I think just looking at it as a question of: by the time they leave, how did it change their perception? • Tom Steller
- But the impact may not show until four or five years down the road. Asking people right after they leave might not have much to do with what you really want to know. That's what worries me – the time scale. • Margaret Fleck
- We have people say, "I came here three years ago and it made me decide to be a doctor," but that's what we get – stories. • Scott Beveridge
- What about these devices enabling evaluation? You would only get a sample but you would get a lot of feedback. • Eamonn O'Brien Strain

Involving Frontline Staff

- One thing I'm hearing is that you have to get the frontline staff involved from the early stages. • Craig Rosa
- That should be extended to all involved or interested parties. For instance, docents are a big issue for me. If they can be involved from the beginning instead of saying to them, "We've developed this: live with it." • Tom Steller
- What if we say, "You don't have to give the same tour over and over, because the device will do that. You get to do the fun things" • Scott Beveridge
- But again, that's involving them from the beginning. • Tom Steller

Ongoing Maintenance - Keeping It Simple

- What about an IT plan or maintenance plan? • Melissa Alexander
- I think that's why you want it to be reasonably simple and standard, so you can keep it going. • Margaret Fleck
- Experience Music has fifteen staff just to keep it going. • Scott Beveridge
- I think it's going to settle down the way the Web has settled down. Select the simple software because it's better. There is also the problem of shifting models. You want to have something simple enough so you can have half this year's model and half last year's. • Eamonn O'Brien Strain
- One of the lessons is that you don't want to use bleeding edge technology. If you really want your Web site to be readable by everybody, don't use some of the trendy extensions. • Margaret Fleck



D. Group Four - The Next Step Project

Group Members

- Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota
- Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University
- Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium
- Margaret Pezalla-Granlund, Museum Consultant
 - Susan Schwartzenberg, Senior Artist, Exploratorium
 - Jim Thornton, Member of Research Staff, Xerox PARC
- Karen Wilkinson, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

i want to be the guide too...

user adding an annotating experience

Museum Driven

I'm going to start for our group, talking about "The Next Step Project." The first characterization of the project is that it is not driven by devices but by the museum itself – by the way the museum encourages new ideas and projects to be formed. • Michael Petrich

In terms of not being device driven, the idea is to not have so many parameters; to look at the big picture rather than focus in right away. • Karen Wilkinson

Not More Content; Different Voices

Also, in this project we are proposing content is not the focus. Even though the mission of the museum is to enhance understanding of science on the part of the public, this is not about content. It is not necessarily that we need more content or content in a different medium, but rather that we need to diversify the sources of the content. For example, a scientist, an artist, and a ten-year-old talking about the Echo Tube. The idea is that different voices might model in some way the education that may happen through personal experiences and interaction. • Michael Petrich

The Role of the Device

Mediator, Manager, Order & Access

This, in turn, will force us to identify a project where the handheld device mediates, whether through devices like audio, or video, or a little pad that allows you to sketch. • Michael Petrich

We also thought that maybe the device's role is to order, suggest, or make sense of the experience. • Karen Wilkinson

It seems that the mediation function of the devices, where we make meaning ourselves, needs to be thought about quite a bit. There was the idea of how we take personal devices and build into them functions more related to the behavior we all have when understanding and sorting information. Probes get into that in some ways. • Michael Petrich

Next Step Project

- Driven by museum not device
- Not about more content
- About different voices
- Device provides access and order
Device as mediator & manager
- Pay attention
- Ratio of investment to payoff
- Take Away

Paying Attention

Models that we might build on includes one at the Minneapolis Institute of Art that Larry Friedlander mentioned. There are four or five works of art and a stack of blank four by five cards. And, posted nearby or scanned in there are cards on which people have drawn their own version of the art or have written what they like about it. What is important is sitting and reflecting, and that is the piece of art that Larry remembered. • Michael Petrich

Everyone who is a teacher knows that what is most important is getting people to pay attention. Can handheld devices help to do that in a really fruitful way? • Larry Friedlander

Investment & Payoff

We also talked about the problem of the ratio of the investment to the payoff. This is highly expensive and time consuming for us and for the visitor, so there has to be a payoff. We have heard how people turn the devices back in if they're too much hassle to use. • Larry Friedlander

Take Away

We want something people can take away and build on so that the experience in the museum is just the beginning, rather than the end. • Larry Friedlander

Questions, Comments, Ideas

Impact on Exhibit Development & Connection Between Exhibits

- One comment I have is, what effect is all of this going to have on the general development of exhibits? At what point do we start to think differently about the way we use the technology so that we can take advantage of it? Or will it limit exhibit development because you can't take advantage of the technology? • Daniel Molitor, Consultant
- That's a terrific point. Exhibit design is a shotgun effect. If you knew content delivery would happen somewhere else you could be more focused, powerful. You're not cluttering up the effect so it could be more streamlined. What if you had a biology exhibit and with the handheld device they could say, "I want it to be about chemistry." You could distribute the exhibit in an interesting way – in the mobile device, not in the exhibit itself. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University
- What goes where is an interesting question – whether in the exhibit or in the device. And yesterday there was the question of whether this should be portable or ubiquitous. • Rob Semper, Executive Associate Director, Exploratorium
- And connection between exhibits is a big issue. You don't want to do it on the floor because you want to have it open, but you could do it with the handheld. • Larry Friedlander
- That's a good point. We think in terms of content development but the best use might be for spaces where there is no physical content – the spaces between. • Daniel Molitor
- For example, in an art museum you might want to focus on color, then go back and focus on historical period. I think there's too much information in museums. I spend five minutes and then go get a cup of coffee. This gives a way to manage the information. • Larry Friedlander
- So it is a device that is almost a manager. • Rob Semper
- It gives *you* the ability to be the manager. • Member of group four

Overheard in Group Four Discussions

Changing Technology - Impact on Goals

- The challenge is always a top-down, bottom-up system when you're doing things in leading edge technology. A lot of these things were not possible five

something that helps me stop - have intimate experience w/ something...

The Role of the Device

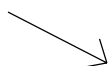
- This is really about how the device can be a mediator and a way of providing attention and focus. • Rob Semper, Executive Associate Director, Exploratorium
- So the device can be mediating with an exhibit and can add different capabilities according to the visitor's questions. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University
- Interesting – this relates to the idea that came up yesterday of visitors using these devices across museums, collecting things of interest to them. • Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

Make it really rich
organized data → *Picking a different voice - to hear from about what you're seeing*

Industry Research Goals vs. Museum Goals & Investment vs. Payoff

- The interesting question for me is that with all this fancy hardware and software you may get something that works, but how useful is it to the museum? Researchers want to push the field, get a bandwidth of usefulness this big into something this small. Museums have to worry about resources. Mixing together research and the mission of institutions is a difficult thing. You don't want to subsidize industry research do you? That's an expensive proposition. If the end result is that it's just adding high tone to a moment that's a lot of money for a small addition. So one thing is, how does it integrate into overall museum planning? • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University

Excerpts from Michael Petrich's notes



years ago because the hardware was not available at a reasonable cost. So there's going to be a tension continually for some time with goals and objectives. • Jim Thornton, Member of Research Staff, Xerox PARC

Using the Technology - Walkie Talkie Toys or Based on the Museum's Mission?

- Daniel Molitor said that in the Port Discovery project they found that visitors want to talk to each other. That's something you could do with walkie-talkies. It's an interesting issue: what *do* people want to say to each other? Let's talk to each other in space and time. It doesn't have to do with devices, toys can do that. • Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota
- Is it based on what the museum wants to do? That's what people do on their cell phones – call to let their family know they're two blocks from home. It should be based on the museum's mission. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University

A Personal Device for Collecting Thoughts, Images, Information

- I am thinking these devices can be more and more interesting depending on how they tailor them. If you can download stuff about light and color, I would like to be able to take pictures too. Rather than downloading data, I would like to use it as a notebook. And later that day, as I rode on a bus to the Museum of Modern Art I could notice how the light looks in the fog. And then I could go to a show on Impressionism and see how they dealt with light and color. • Susan Schwartzberg, Senior Artist, Exploratorium
- So museums would be the context with museum resources available. • Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota
- But you could chose what you wanted. • Susan Schwartzberg
- And the museum wouldn't be defining it. • Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota

Moving from guide model → invitation model

STUFF we share → how do we let them create something else w/ this...

connect museum experience → real world experience

design it so you don't have to do much w/ device (menus etc...)

Being able to invest/construct meaning into the thing....

more flexible / access info. → but add new things

(capturing) conversation starters

commenting/talking about something.... → add one more environment (like outside.)

VI. RELATED PROJECTS & RESOURCES

A. Museums & Historical Places

“Animal Guides” - a cuddly approach

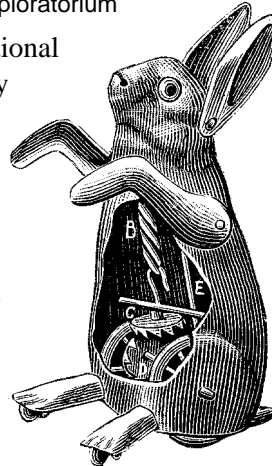
- Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

In an article from England I read about a project by the National Museum in Stockholm that involved handheld devices, they use stuffed animals as guides. I can remember a snake saying something like, “Oh, that rock looks nice and warm.” The idea is that you are looking at artwork from an animal’s point of view. They tried different animals and decided on an owl. There was also a bat that looked sort of worried but tough. It was interesting how the children were comforted by holding an animal when looking at a scary painting.

The article was in GEM News: <http://www.gem.org.uk/gemnews.html>

The researchers are from the Interactive Institute:

http://www.interactiveinstitute.se/emotional_eng/projekt/museums.htm



mak.frankfurt (Museum of Applied Art in Frankfurt)

- Andrea Bandelli, Museum Consultant

They have Apple ibooks on a wireless network that you can use to access deeper content about the objects on display. For example, if there is a Japanese book on display, you can use the I-book to see all of the pages in the Japanese book. So the digital format allows you to see more than you would otherwise. The problem is that the I-book is heavy to carry and people aren’t expecting a laptop in an art museum. When it was made available, only a few people asked for it.

They also have another project with Nokia using mobile phones that includes games for children in which they answer questions or find objects. This is a technology experiment; the idea of having a game is not a priority of the museum. It works, but it’s not clear who will pay – there is a problem with costs. People pay for their own phones and the locals all have mobile phones but for tourists it involves paying a high price.

For more information see their Web site at <http://www.mak.frankfurt.de> or e-mail the museum at info@mak.frankfurt.de

ARIF - A Resourceful and Intelligent Friend at Petrosains Museum in Malaysia

- Rob Semper, Executive Associate Director, Exploratorium

ARIF, A Resourceful Intelligent Friend, is a touch screen sensitive wireless communications device which provides visitors to Petrosains with an interactive text, image and audio guide to the museum. Petrosains is a science discovery

Building a List of Related Projects

We would like to start developing a list of other projects we should know about that are doing related work. • Rob Semper, Executive Associate Director, Exploratorium

Straps for handheld devices

This company can do a custom job – you send the specs and they send you a prototype. They can also do a sleeve for the device. rhodiana.com

Smithsonian Air and Space Museum

I heard the Smithsonian Air and Space Museum was doing something along these lines. Has anyone seen it? • Rob Semper, Executive Associate Director, Exploratorium

centre located in the Petronas Towers in Kuala Lumpur, Malaysia involving 7000 m² of exhibition with a mainstream story-line based on S & T of oil and gas. ARIF is a modified hand held computer (Apple Newton) that receives radio frequencies similar to modern car radios. One receiver scans all the while, the other locks the strongest signal and this informs the computer to load files related to the area from which this strongest signal is detected. This provides a sense of intelligent to ARIF as it recognizes the location of the visitor automatically.

Tajuddin Majid, Head Exhibit Maintenance, Petrosains

Geoff Snowdon , Associate Executive Director Petrosains, SDN BHD Kuala Lumpur, Malaysia

info-petrosains@ptronas.com.my

Experimentarium, Denmark

- Andrea Bandelli, Museum Consultant

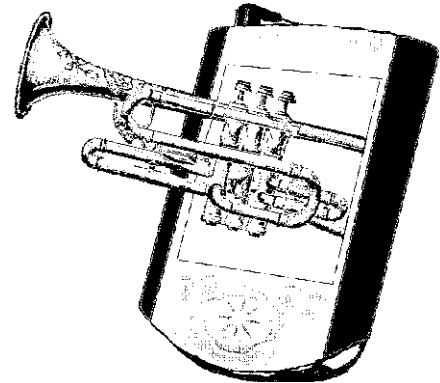
The Experimentarium has introduced a new SMS service with the goal of giving each individual visitor an experience that is adapted to his or her personal interests, to be a kind of personal servant to the visitor, suggesting various activities and reminding the visitor of displays and activities experienced during previous visits. The long-term perspective is to offer intelligent exhibitions where visitors can recall and reuse previous experience.

Project manager - Mads Hammerich
www.experimentarium.dk/uk/pressecenter/pressemeddelelser/sonofon.html

Experience Music Project, Seattle

- There is the Experience Music Project in Seattle, but three out of five people I know turn the device back in after twenty or thirty minutes. • Daniel Molitor, Consultant

- It's a CD ROM player with headphones and a handheld device. You point to any object in the gallery with infrared and get music and audio. The amount of information is incredible. Whenever you see instruments or records on display, you can listen to their sound with excellent quality. The problem is that it is very isolating, and you have to carry three things: the headphone, the handheld device, and the CD ROM player. It also distracts you from the objects themselves as you read the text on the screen or listen to the audio. It has potential but I'm skeptical. You get the devices free when you buy a ticket. • Andrea Bandelli, Museum Consultant



- They're planning to roll out another feature where you can use bookmarks. • Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

<http://www.emplive.com>

Doges' Palace in Venice

- At the Doges' Palace in Venice they are using Casio Cassiopeias. They have a couple of hundred in multiple languages. When I was there they had run out of the English ones, so they are being used. They rent them out to visitors. • Allison Woodruff, Member of Research Staff, Xerox PARC
- It's not wireless, it's map-based navigation. There is a visual interface based on a birds'-eye-view map. When you go into a room, it has information about all of the various objects in the room; they dump all of the information about an object at you and you pretty much have to listen to all of it. It's more like an audio tour with visual orientation. • Paul Aoki, Member of Research Staff, Xerox PARC

Lancaster Guide Project, England

- This is an historic town center where they are doing a very rough automatic location-detection. It tells you about the castle you're in, the history of the castle and so forth. It does a lot of dynamic generation of the content based on your route. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories
- It's also based on time of day, when things are open, and it's wireless. • Eamonn O'Brien Strain, Research Scientist, Hewlett-Packard Research Laboratories

<http://www.guide.lancs.ac.uk/overview.html>

B. Education Projects

MindSurf - a new division of Sylvan Learning

- Daniel Molitor, Consultant

The people at Sylvan Learning in Baltimore have a relatively new division called MindSurf. There is an education program they're rolling out and offering to high schools. They're now using a Handspring device with their own custom software, mostly media related to lesson plans, and are also using off the shelf software like daytimers and so forth. They check out the devices to the kids and if the kids lose them they pay a nominal fee (for a \$500 device they pay \$40 if they lose it). If the kids' parents or the school sign up for the premium version they will wire the school and have additional features available.

<http://www.mindsurf.com/>

C. Audio Experiences

Lonely Planet Digital City Guides

- Katherina Audley, Content Developer, Electronic Guidebook Project, Exploratorium
Lonely Planet just finished building digital city guides for handheld computers. You can download the multi-format guides onto a variety of formats. Research on how people use them out in the world is something we can learn from.
- Q: That's an odd combination – guidebooks to places with no electricity.
- A: They're out on the internet which is all over the world by now.

<http://www.citysync.com/about/about.htm>

Antenna Theater

- I'm thinking of Antenna Theater – not the audio guides they do for museums, but their own art, environments that you move through. • Melissa Alexander, Project Director, Origins, Exploratorium
- They're basically art installations. They set up an intriguing relationship between devices and people. • Rob Semper, Executive Associate Director, Exploratorium

<http://www.antenna-theater.org/>

Business & Industry

Industry Web Sites

- Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston

You could go to the Web sites of Palm and Handspring and look at their grant awardees for interesting ideas for next steps.

<http://handspring.com>

Downloading Into Your Palm Pilot

- There's a project here at the BART station where they beam things into your Palm Pilot. • Rob Semper, Executive Associate Director, Exploratorium
- It's Wideray - they download a reader and custom guide. • Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium
- In many conferences they have a docking station for Palms and they fill your Palm up with stuff. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

One company that does this: Friendlyway.com

Business & Industry

H.P. Executive Briefing Center in Cupertino

- Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

This is a briefing center where executives from HP's customer companies come to hear about our products and how we can help their businesses.

The new, redesigned center has technology similar to the Electronic Guidebook project at the Exploratorium. There are infrared beacons posted at certain locations, and visitors walk around the building with an HP Jornada which can pick up the beacons which the visitor desires to collect.

There are also "stations" where the visitor can offload the beacons collected, and the corresponding URLs are incorporated into each visitor's personal web page at the briefing center. This page remains active for 90 days after their visit so that they can explore the links which they picked up from the beacons at their convenience.

Soundtrack Productions, Inc.

- Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

This is a small company that does audio guides for museums in Mexico that just rolled out an iPAQ version. Their handheld is called "Navip@ss."

Soundtrack Productions, Inc.

www.soundtrack.org

3600 Cerrillos Road, Suite 1108, Santa Fe, New Mexico 87507

(505) 820-6744

Sound in Urban Spaces

- Susan Schwartzenberg, Senior Artist, Exploratorium

This isn't really a handheld project but it's interesting. It's an artist team that does public projects in urban spaces that tell you about the history of the space. You go into a phone booth and dial an 800 number and you hear an oral history from someone who lived there years ago, and so forth. It's the idea of being in an environment and using an instrument to find out additional information.

- They also did something on the anniversary of Nagasaki. • Melissa Alexander, Project Director, Origins, Exploratorium

Janet Silk and Ian Pollock

<http://www.gardenofeternaltime.com>



VII. CONCLUDING THOUGHTS

A. Continuing This Dialogue, Expanding Involvement

A Separate Forum or Part of Museum Association Meetings?

- We held this forum because it is part of a grant. Is there something about this community that makes sense, or do we want to ensconce this in wider museum meetings? • Rob Semper, Executive Associate Director, Exploratorium
- Did you present this at ASTC and if so, how did they respond? • Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston
- There were a lot of people there and everyone in the room was involved with or seriously thinking about something like this. It seems like lots of museum folk out there are interested. • Doug Conaway, Resource Development Director, Center for Media Communication, Exploratorium
- I heard from two opinionated exhibit design people. One said, "This sounds like technology looking for a purpose." However, the same person also had an idea about designing their next exhibit with something like this in it, so it wasn't quite so negative. What about art museums? Are they talking about this? • Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium
- I'm not sure. • Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art
- For this forum we wanted people from different components (museums, industry, etc.). Does it make sense to attach it to other museum conferences? • Rob Semper, Executive Associate Director, Exploratorium

Involving Others In The Dialogue

- I suggest if you have another meeting, that preparation for the meeting be a communal effort. It was helpful hearing what others are doing. You could get names of other people and institutions doing things. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University
- It might be interesting for people who are about to start, if they serve as case studies and we revisit what they are doing in one or two years. I like Larry's idea, but I also like the idea of following the people who came to this forum over time. • Melissa Alexander, Project Director, Origins, Exploratorium

Introduce the Devices to the Dialogue

Maybe the next time we have this meeting we should use these devices and see if it helps us. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University

Value Of A Separate Forum

- I think the depth of what we have accomplished at this forum is considerable. One thing I've gotten from it is the idea of questions I should address. I would argue for a separate forum. We are where the Web was ten years ago. • Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota
- This feels like the right group of people talking about the right things. For a two day gathering this has been very productive for me. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

Collaborating on Convening Another Forum

We could collaborate with someone else to convene another meeting – it takes a lot of effort. I am hearing interest in doing something more. • Rob Semper, Executive Associate Director, Exploratorium

A. Final Thoughts

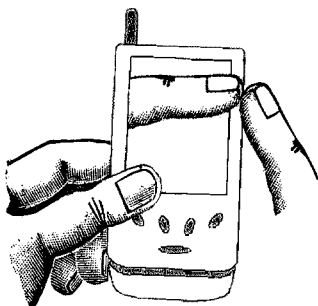
A Call For Final Thoughts

I'd like to conclude with final thoughts you may have about what we have discussed. Is this worth it? What are you taking away? I would like to ask Goéry Delacôte, who has given a lot of thought about how this relates to this institution, to begin. • Rob Semper, Executive Associate Director, Exploratorium

Benefiting From Diverse Input & Views

I was going to say exactly what Goéry said. I think it has been really interesting. Rob and I started working on funding for this project three or four years ago and some of our original concepts have turned out to be true. It's been an interesting process but what's been missing is an understanding of what others are doing or thinking; where our work fits in a bigger landscape.

Because I'm not an IT person or a content person but have a superficial knowledge of lots of things, it was good to hear from people with expertise in these areas. • Doug Conaway, Resource Development Director, Center for Media Communication, Exploratorium



Simplicity And Integration

• I'm sorry I have not been able to be here during the entire session with you. I thank you all for being here and I am glad this is a mixed group of museum and industry people. It is good to have two groups asking different questions. I want to tell you why I am interested in what you are doing, but first there is a contradiction I have to address.

Museums like this one are rich in two things: the first is artifacts designed by talented, intelligent people; the second is people, both staff and the people who come here. And at some point they are all here, all together or in sequence, and that is what you have as a resource.

Some people cannot be part of that richness and have no access to that richness. When I have a visitor and I take them to an exhibit I discover things about the exhibit I would not otherwise have discovered. There's a depth of field that is huge. I hope you realize that depth here. This is very different than a single concept; it is experiential and complex.

So my main goal is to give people better access to this richness, to give them a deeper experience. The question is: how?

You are talking here about a portable tool, and I am very much in favor of trying that. But here is the contradiction: if you have a complex tool, it will be at a price we cannot afford. We have to focus on the things that are necessary to have on the tool so that it is useful; we need to eliminate.

So on the one hand we want to go deeper and more subtly in the experience with people and things. On the other hand we need focus. Part of the confusion may be that we are talking about two different things.

One thing is that it may not be a tool that is needed; it is a set, a battery of things. I was talking yesterday about whether we want portable or ubiquitous computing. It can be both. What you may have is a study of the ecology of a complex set of tools. So make decisions about portable devices within the context of a more complex battery of tools.

So in future sessions it would be good if there was discussion about portable devices with a united focus; about access; about consistent design compatible with other tools.

When you meet, I would ask two questions. First, what success have you had in focusing the use of the tool to address only a few questions well? Second, what success have you had in developing a global system of stimulation to deepen the access of people to this environment?

In places like ours, people barely scratch the surface because of time, history, and present trends. So I would like you to look in these two directions: simplicity and integration. • Goéry Delacôte, Executive Director, Exploratorium

A Beginning Focus

- For me this has been a very rich experience and a lot of issues were raised. What I am hearing is that we are far from a solution, but at least have identified some focuses and can now move ahead. • Andrea Bandelli, Museum Consultant
- It was great to hear so many different voices. The discussions helped us focus down on things we can take away. • Rakhi Rajani, Researcher, Hewlett-Packard Research Laboratories

Real World Applications, Specific Scenarios

- It was interesting to see real world applications and systems. In the research world you see a lot of hypothetical and lab situations, so it was good to see actual projects. Another thing I found interesting was that I'm not in the museum world so it was interesting to see this in one specific scenario – museums. I also think it's promising that people are thinking about a whole range of issues. • Jenna Burrell, Application Concept Developer, Intel Architecture Laboratories

Forming A Network of Contacts

- I agree with what has been said previously. One thing that I'll take away is who is working in this area, thinking about this area, doing specific things – who I can contact when I have questions. • Paul Aoki, Member of Research Staff, Xerox PARC

The Spirit of Sharing and Cooperation

- I think after having worked for many years on products with the idea of beating the competition, I found the atmosphere here was one of true cooperation and sharing knowledge which was very constructive. • Marcos Frid, Research Engineer, Hewlett-Packard Research Laboratories

Informality and Honesty

- I just have a lot to think about and this will push me to think harder. I was worried that the tone of this session would be too formal, or people would mainly be trying to get across the idea that their own project was great. This had a really good tone. • Natalie Rusk, Project Director, Electronic Guidebook Project, Exploratorium

Ideas and Motivation

- I have similar feelings about the communication aspect. I also gained many ideas for future projects and am motivated to finish our evaluation. • Susie Wise, Senior Producer Interactive Educational Technologies, San Francisco Museum of Modern Art

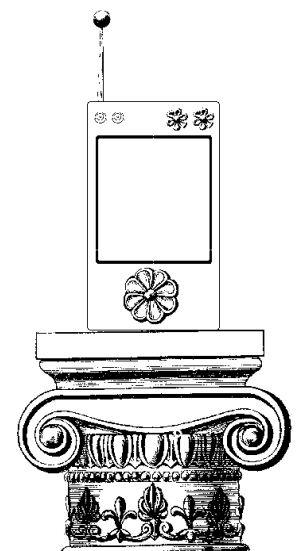
Experiences, Evaluation Ideas, Communicating With the Community

- I'll echo the previous sentiments. I found others' experience interesting. Our focus is on evaluation so learning what others find interesting, valuable, or

Be Holistic, Think Active and Personal, Forge Ahead

I have three thoughts (in addition to saying thanks for inviting me).

1. Think about all of this holistically. Don't divorce the function or purpose of the devices from that of the institutions. These have to tie in to our physical spaces and activities.
2. Think active and personal. The reason people get a Palm Pilot is that it allows you to control your environment. Since that's a function, figure out how to glom onto that. Not complete control, but something along those lines.
3. Even after we have identified all of the challenges and problems have no fear. Go ahead and do it and we'll have a whole bunch of new horror stories to share. • Daniel Molitor, Consultant

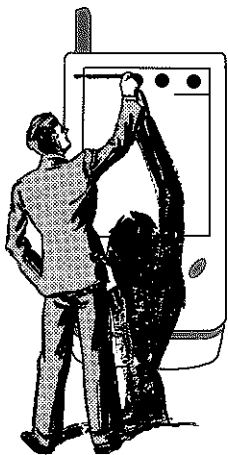


Simplify

The message to me is simplify, simplify, simplify. And it's a message that we can extrapolate to so many different things, to other situations. • Mirjana Spasojevic, Project Manager, CoolTown Program, Hewlett-Packard Research Laboratories

Focus, Simplification, and Future Feedback From Visitors

As we think about prototype design involving no more than five units, there are some things I'm eager to take back from this: focus, and making things simple. In our evaluations we ask people to tell us what they've just been through was about. The answers can range from "fish" to, "I did this . . ." I will be interested to see how their language changes with this. • Michael Schiess, Project Manager, Physical Science Interpretation, Museum of Science, Boston



noteworthy is helpful. Also learning how we can communicate better with the community.

Other than that, we'd be happy to publish in forums or appropriate places for the benefit of others in the field, just tell us where. • Allison Woodruff, Member of Research Staff, Xerox PARC

Importance of Personal Content, Ideas About Text/Audio/Video

• For me what was tremendously affirming was finding that personal content is so successful. If people can relate it to themselves, they have a deeper experience. And that people wanted more personal stories about Exploratorium staff members. I feel I can go full speed ahead.

It also really surprised me in terms of what works and what doesn't regarding use of sound, versus video, versus text. I want to conduct research about that.

I was pleasantly surprised to see that even though people are skeptics about the technology, they're still jumping in with these projects. I find that encouraging. • Katherina Audley, Content Developer, Electronic Guidebook Project, Exploratorium

A Clear Model

• I feel these two days have given me a better sense regarding what a project like this takes. I'm coming away with a very clear model, where there is a pattern and the issues are clear and how this fits into the museum experience. • Deborah Lawrence, Manager Interactive Technology Audience Services, San Francisco Museum of Modern Art

Candid Stories, Common Problems

• This was really fun, and what was most fun was that the stories from others were candid instead of polished presentations. It's heartening to hear that others are hitting the same problems and issues that we are – to find out common problems so that we can reach common solutions. It would be nice to have a forum with a wider range of museums but the problem is that if you have different types it could get messy, with some just starting, some still just thinking about it. There would be a range of requirements. • Margaret Fleck, Senior Researcher, Hewlett-Packard Research Laboratories

Creating Killer Apps That Blend Knowledge and Explore Beyond

• I've come away with a renewed sense of optimism about the potential for this technology to take the Exploratorium beyond the walls of the museum. This comes from an aside of Susan's. Imagine a tour of phenomenon in the city augmented by Paul Doherty and an artist created for the handheld. I'm not worried about people having to learn to use the technology. A pencil is technology and we all had to learn how to use one at one time. • Melissa Alexander, Project Director, Origins, Exploratorium

A Better Sense of How This Might Fit

- We are at an early stage and it was good to hear that others have similar concerns as well as hearing the potential. I picked up new ideas about what could be done as well as some cautionary advice. What I liked best were the candid stories about real experiences where you got significant feedback and input. I have a much better sense about how this might fit in our larger gallery installation plan in a way that is appropriate to our space and our objectives. • Tom Steller, Chief Curator, Natural Sciences, Oakland Museum

Universal Problems & Whether Technology Will Toss Us Some More

- Although we're not walking away with the solution, it's good to know that the problems are universal. I think it would be interesting if this group got together a year from now because the technology is changing so quickly, I wonder if we would hear the same problems or if technology would have generated yet more problems in the interim. • Michael Drennan, Technology Developer, The Tech Museum of Innovation

Time to Jump On The Bus & Swap Notes With Fellow Passengers

- I'm just getting the lay of the land. I had heard glimmers about what SFMOMA and the Exploratorium were doing and thought, "God, the bus has left the station!" I'm glad no one asked me what The Tech is doing because I didn't have an answer. I felt it was crass asking about how much money each project spent and found that everyone was happy to say without making us sign a nondisclosure agreement. I feel I can call anyone here and ask questions, and that others' mistakes can help me figure out what we should do. I can now write a one-pager about how to continue, what to do. It's here, it's interesting, and it's early enough so that I think The Tech can make a contribution. And I would also like this group to get back together in a year – I think I'm the sixth person to say that. • Craig Rosa, Director of Information Technology, The Tech Museum of Innovation

A Variety of Solutions Enhancing Distinct Experiences

- I'll be the seventh to say we should all meet again. It was good to see how different people use different applications to solve different problems. There are so many different solutions people have tried that are working to create experiences that are engaging people. It's not about a silver bullet, it's how to add to a particular experience. • Scott Beveridge, Internet and Multimedia Exhibit Manager, Museum of Science and Industry, Chicago

A Continuum of Possibilities

- I'm more inspired, and I'm interested in investigating the continuum between the device as an information giver and a tool for content creation, • Michael Petrich, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

Pioneers in Early Development

I remain optimistic about the potential but this is clearly hard and takes a lot of work to do well. People need to bring their passion and interest to reach the goals of their institutions.

I'll echo what has been said about the range of the field – you get a feeling of chaos. But people shouldn't be afraid to do things; chaos is the mark of a field in early development and the only way to learn is to step out and do experiments. The people here have the chance to be pioneers. • Jim Thornton, Member of Research Staff, Xerox PARC

No Clarity, Some Questions

I was hoping for clarity and I didn't get that. I think we do need to question whether we are taking the right direction or do we need to reconsider. • Karen Wilkinson, Co-Project Director, Playful Invention and Exploration Network, Exploratorium

Potential and Intriguing Questions In A New Domain

I am coming away from this forum thinking we are on the right track. My hunch was that there was potential for these devices, mixing networks and public space, and I didn't hear anything to contradict that hunch. To me, the questions that emerged are as interesting as the results. And it was interesting to me to get these diverse communities together and talking.

I want to thank you again for coming to build this learning community where we are starting a new domain of work. That's what this is about. • Rob Semper, Executive Associate Director, Exploratorium

Good Take-Away Ideas For A Starting Museum

- I'm changing my feeling of initial scepticism to one of critical enthusiasm. This has been perfect for giving me something to take back to my museum. It allows me to take ideas, suggestions, questions, so for a starting museum, this has been ideal. • Keith Braafladt, Director of Learning Technologies, Science Museum of Minnesota

Interrelated Points Emerging From Chaos

- Regarding the question of whether we got anywhere with the chaos, as I look at the butcher paper postings on the wall it looks like the usual chaos. But we had the same discussion a variety of different ways and it's possible to see that it is all interrelated. • Margaret Pezalla-Granlund, Museum Consultant

A Sense of "Aha" And An Urge To Go Deeper

- I'm sorry I missed the first day of this session and I'm sorry I missed the project demonstrations, which I really wanted to see. The thing I care most about, as a theater person and as a teacher, is giving a shapely experience that extends in time. I don't want to be part anymore of overwhelming people. I discovered as a teacher in the past that I'm successful if there are two things I can bring together – a sense of "Aha!" and the ability to penetrate deep. If we can use this to give people a moment of perception and insight that they can grapple with and use, we will have been successful. So if I were doing this research I would focus on what precisely it is that can awaken a person's attention that will make them want more and more and explore more deeply. • Larry Friedlander, Professor; Co-Director Stanford Learning Lab, Stanford University

