16 DESIGN DRIVEN ORGANISATION

Extending The Museum Context

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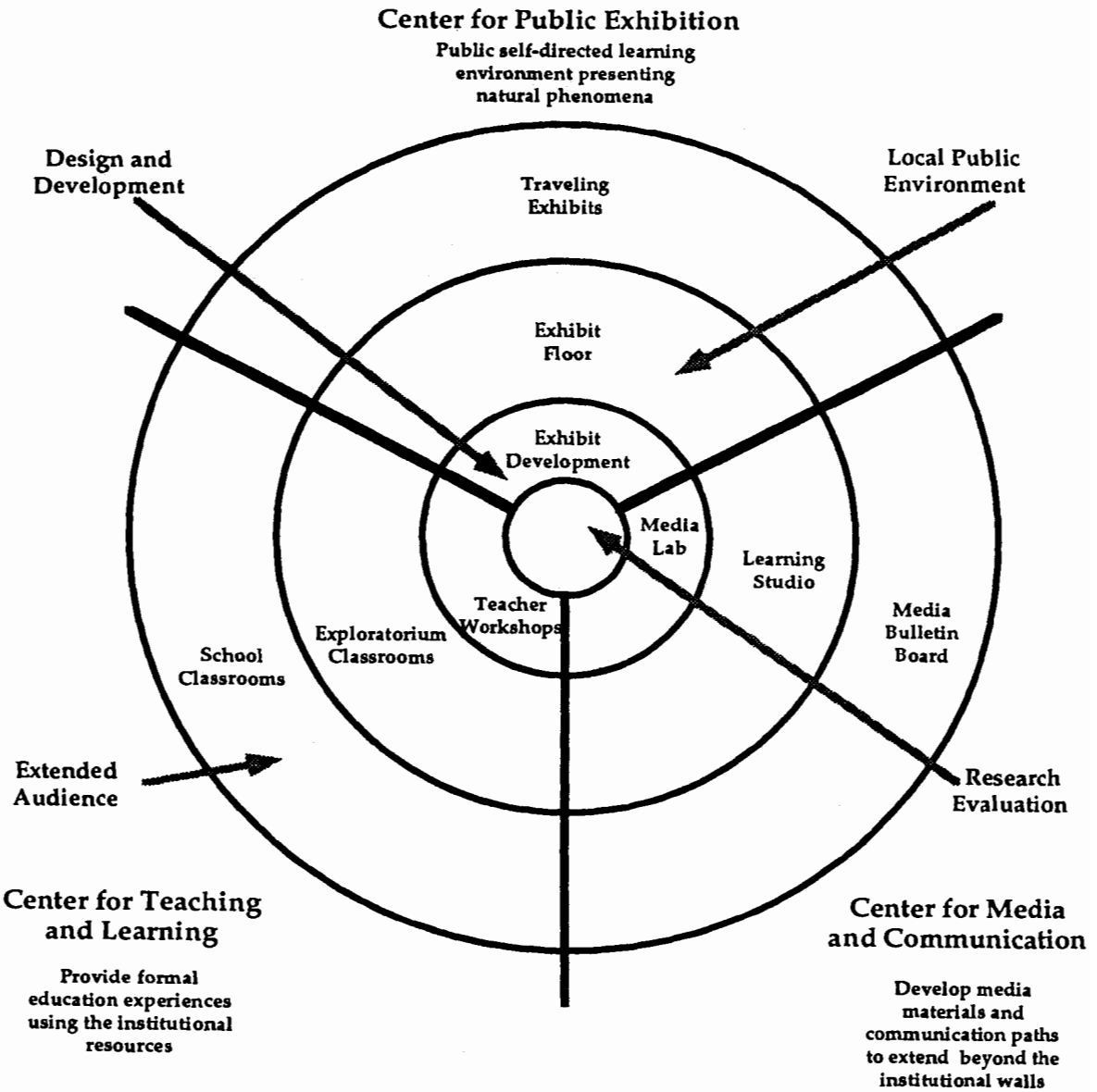
The Exploratorium was founded in 1969 by Dr. Frank Oppenheimer to provide the general public with direct experiences with the phenomena of the physical and natural world which enable them to begin to develop an understanding of that world. Based initially on the development of a unique collection of interactive exhibits, over the years the institution has expanded its efforts in providing meaningful access to natural phenomena through the development of enhanced field trip experiences, school teacher education programs, and the creation of teaching materials and products based on the museum's exhibitry. The Exploratorium's educational philosophy has always been based on providing social learning opportunities through direct personal experience. In all of its work, the Exploratorium tries to convey a pedagogy of curiosity-driven learning as well as specific content material. As a public museum and professional learning centre, the institution develops prototypes of new learning environments and learning tools for people of all ages and backgrounds to help learners take charge of their own learning and to help educational institutions fundamentally change the way they educate.

Organisational structure

The organisational structure of the Exploratorium is designed to foster its mission of design, development and presentation. The programmatic efforts of the institution are now pursued by three interrelated centres of activity; the Centre for Public Exhibition, the Centre for Teaching and Learning and the Centre for Media and Communication. This organisational structure, established in 1991 by the new Executive Director, Dr. Goéry Delacôte, is explicitly designed to recognise the different approaches needed for different modes of presentation and different audiences (see Fig.1).

Fig. 1 The Exploratorium Organiastion

The program of the Exploratorium is divided into three interconnected centres of activity which corresponds to different pedagogical styles and different modes of presentation. Each centre is designed to closely couple a design and development component, a local public environment and a relationship to an extended audience.



The primary public learning opportunity is offered by the public exhibition environment developed and operated by the **Centre for Public Exhibition (CPE)**. This space includes 650 interactive exhibits and associated programming which support inquiry-based education for 660,000 visitors per year. Beginning in 1969 with the development of exhibits focused on human perception, the collection has been extended over the years to include such topics as vision, light and colour, hearing, sound, waves and resonance, electricity, heat and temperature, weather, patterns in nature (mathematics), language, cognition, and a biological sciences area including animal behaviour, neurobiology, cellular and molecular biology, immunology, and genetics. These exhibits provide examples of the phenomena of nature and science to the public and serve as props for the visitors to teach each other and themselves. The intent of these exhibits is to isolate a particular phenomenon from nature enough to make it accessible to direct study without reducing its form to such a caricature that it looses its beauty and richness.

The exhibit space is designed to be an environment which encourages exploration and the process of learning. Designed to provide an experience similar to a walk in a woods of phenomena, the exhibit space is situated inside a cavernous open space of 105,000 sq ft with a 65 foot ceiling. The museum's exhibit spaces, offices, development shops, classrooms, and theatre form a small educational townscape complete with a town square, an industrial park, neighbourhoods and roads. This spatial layout encourages a sightseeing approach equivalent to what one does in a visit to a new city or in a walk through a park. The choice of where to go and what to see is left in the hands of the visitor. Open development shops expose the exhibit development process to public display. It is possible to see and interact with the artists, scientists and educators who develop the exhibits for the museum floor. This feature, along with the accessible, open design of the exhibitry gives the space a "work in progress" feel which encourages curiosity on the part of the public.

Beyond supporting general public visits, the exhibits also form a resource base for formal pre-college and college-level classes, for extensive enhancement activities for teachers of grades K-12, as well as for publications and products that export the museum experience into schools and homes. The **Centre for Teaching and Learning (CTL)** was developed to support the more formal use of the exhibitry, especially for the teaching of science and mathematics in schools. This centre serves a network of over 2,500 San Francisco Bay Area teachers in grades K through to 12 with intensive workshops and follow-up seminars designed to use the exhibit and staff resources of the Exploratorium to foster increased effectiveness in formal education. The teaching staff of this centre also develop learning tools for use by classroom teachers in their classes which exemplify and encourage inquiry-based instruction. This centre also sponsors the structured field trip program for visiting classes and students and the high school explainer docent project and is also responsible for outreach programmes that annually reach more than 3,700 underserved children throughout the city. Currently the Exploratorium spends as much of its resources supporting this activity as it does supporting its exhibition work. While the mandate of CTL is clearly concerned with formal education, it is important to be clear that this is not the "Education department" of the Exploratorium. Since the institution as a whole thinks of itself as fundamentally an educational institution, the CPE is as much a locus of educational activity as the CTL.

Part of the mandate for CTL is the translation of the exhibit based pedagogy of CPE into a form usable in the classroom. A recent example of this is the Exploratorium Science Snackbook. Created by teachers attending our teacher development workshops, this book contains suggestions for building inexpensive classroom versions of Exploratorium exhibits for use by teachers or students. For example, to show the formation of clouds the Exploratorium has a Cloud Chamber exhibit which consists of a chamber containing a

small amount of water and a vacuum pump to reduce the atmospheric pressure in the chamber. Under a vacuum the water vapour condenses into a fog. The classroom version in the Exploratorium Snackbook suggests using a large glass jar with a small amount of water and a rubber glove hanging in the jar attached to the opening to seal it off. When you stick your hand in the glove and pull it out of the jar, a partial vacuum is established and a cloud of water vapor forms. This snack successfully translates the experience with this phenomenon from the exhibit floor to the classroom.

The **Centre for Media and Communication (CMC)**, the newest of the three organised centres of activity of the Exploratorium, is dedicated to fostering an understanding of science and nature through the use of representational media and different forms of communication. Currently under development, this centre uses technology from publications, videotape and CD-ROMs to interactive computing, public media production, and communication networks to carry the Exploratorium's pedagogy beyond the walls of the museum. It is also responsible for developing interactive media tools for learning to use within the museum and in the formal education programmes. This centre was created by joining existing departments such as graphics and editorial with a new media department, consisting of video, photography, educational computing and audio production. In addition to these media production departments, the existing library functions as a centre, serving as a key public venue for both visitors to the museum and remote users of the Exploratorium.

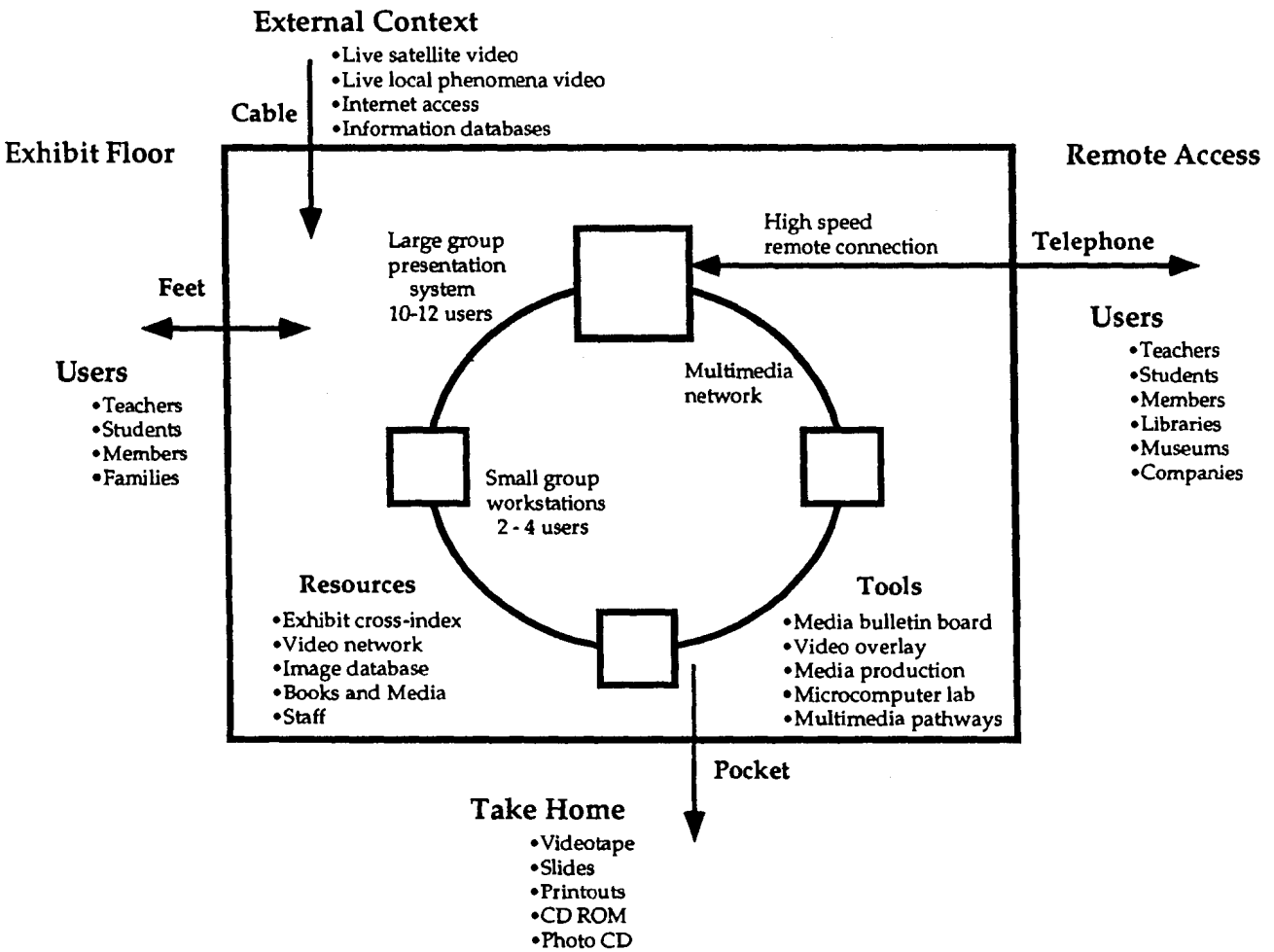
The goal of the Centre for Media and Communication is to provide experience with phenomena to an extended audience as well as provide experiences with new phenomena not easily presented in three dimensional exhibitry. As part of this centre we are creating a learning studio, adjacent to, but separated from, the exhibit floor (see Fig.2). In the style of an artist's studio, a workroom where all sorts of materials and tools are available for the artist to choose from, depending on the project at hand, this learning studio will have all manner of multimedia learning tools, visual, text, and audio material and telecommunication capability for data and real-time video retrieval. The studio will be staffed by a facilitator and will contain materials and multimedia pathways specifically designed for group learning. An essential feature of the learning studio will be the development and use of learning tools which support conceptual development through interactive media conversations, data acquisition, media production experiences, and opportunities to be reflective about one's own learning and the learning of others. In addition, the learning studio will naturally serve as an electronic network hub providing the Exploratorium experience to remote users.

The learning studio will be a new learning environment in the Exploratorium that will exist educationally as well as physically halfway between the exhibit floor and the museum's classrooms. As such, it will have its own educational dynamic including support for longer interaction times than the exhibit experience, the potential for small-group discussions and mixed-media production activities, and opportunities for research and experimentation. The learning studio will also be a natural place for discussing current natural and scientific happenings by providing connections to on-line scientific data, live video and information services, and scientific news sources.

An important part of the learning studio experience will be users-created presentations with media and computer graphics that stimulate group discussions. Apple Computer has already developed a prototype of a multimedia learning tool called a **media bulletin board** which they have made available to us for use in the learning studio. The computer screen of the media bulletin board is composed of thumbnail images with captions and annotations representing digital movies, stills, or animations structured as a multimedia object in a database. These video notes can have audio annotations added by different authors. Each bulletin board frame can contain up to 12 digital video messages with text

Fig. 2 The Learning Studio

The Learning Studio is a new public environment for the Exploratorium under development which provides learning tools for visitors to use both in extended study within the centre and on the floor of the museum.



and audio. By clicking on each image, a short digital movie or still image is displayed along with an audio quote and text. Users can easily create new video messages, audio annotate existing messages, add pre-recorded background messages stored in a database, and move messages about on the board. These thumbnails can be placed in different spatial arrangements on the screen and connected by captions to create an intellectual story line. The underlying multimedia objects can be linked through a network so one user will be able to share them with others in the studio and with remote users at schools or at home.

Recent work connecting the Exploratorium with a local elementary school classroom in nearby Marin County using this bulletin board has indicated to us the great educational potential of connecting a museum with remote users through a high bandwidth multimedia network. In this experiment, students videotaped questions about weather as part of their classroom discussions and local field trips and sent these questions to the Exploratorium for its staff to answer. Answers were provided either as audio comments or as video vignettes of exhibits or activities which could be recreated in the classroom. Students then visited the museum on a field trip and created a final project using the video material they shot at school and in the museum combined with material produced by the museum staff. Because the fourth grade teacher in this case had not taught science extensively before, she relied on access to the Exploratorium staff for expert support to give her confidence to proceed.

We discovered that the bulletin board concept, with student and museum staff produced vignettes, encouraged significant exploration and discovery on the part of the students and transformed the class field trip into an engaging learning activity. Through this sort of project the CMC supports the activities of both the CTL and the CPE.

Design driven development

In addition to the explicit educational design demonstrated by the existence of the three programme centres, the centres have a parallel internal design structure which supports their activity. Each centre has a design and development component, a local public space component, and an outreach component which extends the work of the centre beyond the museum itself. The CPE has the exhibit development shops directly connected to the exhibit floor providing the public with the sense of the development process and providing the exhibit developers with the reality of the audience for their work. The centre also develops exhibitry which forms the basis for exhibitions and programmes at other sites. The CTL has an in-house faculty which develops an exhibit-based teaching curriculum for use in the museum's classrooms which are also directly adjacent to the exhibit floor. The participating teachers in our teacher development workshops then extend the Exploratorium's ideas to their students in schools throughout the community. The CMC has media production facilities in direct contact with the developing public space - the learning studio. It also creates media such as publications, products and interactive media products for schools and home use.

The existence of the design and development component in direct conjunction with the public component allows us to develop our educational materials and experiences in a way that they can be tightly adapted to the actual users. Each of these development shops also works on projects to support the other two centres, thereby fostering a link between the activities of each. And each centre looks beyond the walls of the museum to reach broad audiences who may never come to the building itself. This institutional as well as physical design fosters the prototyping and testing function which is critical for the development of successful tools for learning.

To support the work of the entire institution we are also proposing to create a small **Education Research and Evaluation** office which will support each of the centre's activities. Designed to provide the connection with the cognitive and education research community, this office will evaluate programmes and inject the results of new theories of learning into the applied programming of the museum.

Conclusion

Our experience has taught us a number of things. First it is clear that the physical as well as organisational design of the institution is critical to the Exploratorium being able to successfully carry out its primary goal of supporting public education. The structure of an organisation must be tuned to match its aims. This interplay between form and function is an ongoing process of the Exploratorium which allows us to adapt to the ever changing needs of our multiple audiences.

Secondly, it also seems clear to us that an emphasis on design as well as presentation fosters the creation of an environment which supports active learning. Modelling the process of creation and discovery requires a staff and facility which is active in the creation of new ideas and new ways of presenting these ideas. This is as true in the new work we are undertaking as we develop the Centre for Media and Communication as it has been for the development of our exhibitry or our education programming. In addition, strong attention to the design of educational experiences or material is as important as a strong emphasis as its pedagogy. But for this experience or material to be ultimately successful, the design must be adaptive to the users. We have found the prototyping process critical to this adaptation by allowing for a tight coupling between the designer and the user. In the best application of this idea, the user actually becomes the designer as part of their experience.

Finally, we are convinced that there is a major role for the use of media in many forms within the museum context. In our case, while the media production activities are contained primarily in CMC, the use of this media quite naturally occurs throughout the activities of the different centres. Media is used to connect the exhibitry to the real world outside of the museum. It also allows us to make visible things which are not easily presented in other forms such as things which are too small, too big, too fast, too slow or too complex. It serves as a tool to visualise conceptual ideas and as a way for visitors to present ideas to each other. It also serves as a platform to prepare students, teachers and visitors before their visit and to support their learning after their visit. And it can serve to present experiences with natural phenomena, still the key idea for the Exploratorium, to a wide and far flung audience, many of whom may not have a chance to visit the museum at all.

Our challenge as we extend our media development work is to keep focused on the goal of providing genuine experiences through the exploration of real phenomena to a range of people in many different settings. It is our belief that the recent developments in media manipulation and interactive communication brought on by the integration of media with computing will allow us to meet this goal.