Collaboration between Research and Development Interests

The Case of The Digital Weather Station Exhibit

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Introduction

The information superhighway is coming to the cities of all museums and zoos across the nation. Board members, patrons, and CEOs are demanding the construction of an "off ramp to their destination." This puts obvious pressures on currators and exhibit designers alike, who seldom have the technical expertise to create electronic exhibitry on or off the superhighway.

What is the answer? This paper provides a case study of one answer: the creation of a mutually beneficial musuem/university collaboration. This collaboration is one that goes beyond the traditional university/musuem relationship of short-term partnership for the development of an exhibit. Rather, this partnership is an extended, on-going relationship between a university faculty member and a museum design team in the development and study of a high-end technology exhibit.

The formation of such an on-going partnership must start with more than the generousity of a faculty member's time and expertise to give the "service" part of the faculty load to a museum. While this undoubtably happens thousands of times a year, the reward structure of universities largely suppresses this type of work in an on-going manner. To be rewarded within the university, professors must do research. Thus, to form an on-going relationship there must be an avenue for continuous research for the university faculty member.

This partnership was developed to ensure that the ability to conduct ongoing research was "built-in" to the both the physical exhibits and the mindset and practices of the museum designers. We will begin this case study by setting the context.

The Context

The Children's Museum of Indianapolis

The world renowned Children's Museum of Indianapolis (TCM) is a very visible feature on the cultural horizon of Inidanapolis. TCM is the world's largest children's museum with 325,000 square feet of exhibit space, over 900,000 visitors annually and an operating budget over $12.4 million.

The Science Spectrum Gallery/Network

On September 9, 1994, TCM closed an entire floor to create a new $8.5 million "Science Spectrum" gallery that will be funded, in part, by a grant from the National Science Foundation. The Science Spectrum gallery is part of the museum's initiative to create an environment in which children, age six to fourteen, conduct science investigations. TCM will encourage in-depth scientific exploration for learning by lengthening children's engagement with the exhibit–both inside and outside the museum. This will be accomplished by extending the walls of the museum into the community and classrooms and becoming a content and service provider on the "information superhighway."

IUPUI

Indiana University/Purdue University at Indianapolis is a growing urban university with over 28,000 students and the state's largest professional graduate schools. The university has recently invested in a state-of-the-art library that will serve as the state's central hub for information technology.

Learner Tools and Learner Centered Design.

Dr. Kenneth E. Hay is an assistant professor of Instructional Systems Technology in the School of Education at IUPUI. His research agenda will be weaved into the exhibit:

Three themes in education converge to shape my research AGENDA: ever-increasing power of computing technologies, the development of the information superhighway, and the growing acceptance of constructivist learning theories. Increased computational power gives learners the ability to create multimedia images, utilize complex scientific tools with relative ease, and explore their world with virtual reality imaging processes. The information superhighway provides access to professional level data, provides easy exchange of information, and facilitates communication and collaboration with peers and experts. Constructivist learning theories put learners in the role of scientists doing authentic tasks. These forces combine to create a need and an opportunity for learners to use computational tools to develop domain knowledge and engage in tasks similar to scientist. The question is: What theories and models can guide us as we create computational tools for learners?

To answer this we must move beyond the current paradigm in Human Computer Interactions founded on Norman and Draper's notion of *User-Centered Systems Design* (1986). This paradigm focuses on designing tools for users, not learners. Just as the user-centered design paradigm was made possible by a dramatic increase in computing power, the latest increase in computer power gives us the capability of meeting the next challenge in HCI: *learning*.

At the Highly Interactive Computing Environment (HiCE) research group we developed tools for learners (Soloway, Guzdial, and Hay, 1994) that focused on making an authentic task easier and on supporting learning specific to the task, the task domain, and the practices of the community.

We developed a new paradigm, Learner Centered Design (LCD), that extends the user-centered design model. LCD is defined as:

> an interface design model that expands the focus on user needs to learner needs. That is, the goal becomes the creation of a tool that is easy to use AND facilitates the development of domain understanding through the completion of a task within that domain.

The partnership will meet the needs of TCM to create an exhibit with a strong "inforamtion superhighway" component and Dr. Hay's needs to conduct research on interface design with the Learner Centered Design model.

The Project - The Digital Weather Station

The Weather Station Exhibit, within the Science Spectrum Gallery, will support children as they explore weather phenomena. It will be an integration of a traditional children's museum weather exhibit and the Digital Weather Station which will be a set of high-end computer workstations for two primary goals: to use online atmospheric data from the internet, and to run a set of computational tools to pose questions, collect, analyze, and synthesize data, and make reports. The exhibit will be comprised of two types of tools: Apprentice Tools and Cognitive Aid tools.

Apprentice Tools Based on Professional Tools. The current suite of learner tools that will parallel these professional tools will be comprised of the Weather Map Design, the Pattern Tool, the Visualization Data Base and Comparison Tool, the Simulation Tool, and the Presentation Tool. Below is a brief description of these tools:

Tool	Descriptions
Weather Map Design Tool	This tool will allow learners to "order up" a 2-D or 3-D weather map from the data that are collected hourly by the National Weather Service or the data collected by learners through TCM's own network infrastructure. This will help learners see weather as a system and weather phenomena as comprised of a combination of conditions.
Pattern, Predictions & Movie Making Tool	This tool will enable learners to create 2-D or 3-D movies of weather maps over time. Thus, they will be able to use it to analyze weather patterns and make predictions.
Visualization Database and Comparison Tool	This tool will support the comparison of sets of visualizations. These sets could include visualizations that have been created by the learner, created by other learners in the past, or that are from the database of prototypical maps and extraordinary weather events.
Simulation Tool	This tool will be a virtual reality, direct manipulation tool where learners can "grab" weather elements and put them together to see what happens.
Presentation Tool	This tool will allow students to be the weather person and create a short presentation of the weather events that they have explored.

Cognitive-Aid Tools Based On Additional Learner Tasks. The current suite of tools also includes two Cognitive-Aid Tools. These are tools that learners will need to accomplish tasks that experts do mentally.

Tool	Descriptions
Event Reconstruction Tool	This tool will help learners make the connection between the visualization, data, instruments, and event when looking at a visualization. Learners will "interrogate" a visualization by clicking a spot on the visualization. The tool will visually represent the data, instrument and weather phenomena through video or a VR recreation of the event.
Data Streams Tool	This tool will enable students to live through a weather phenomena, via video, and see the reactions of several instruments, changes in several data sets, and changes in several different visualizations simultaneously. This will demonstrate to them that all the data is being generated by the same weather event and that we can see an event through different "lenses."

Issues in Collaboration

The cornerstone of this collaboration was laid in three ways before the work began: the receipt of an institutional blessing from leaders at both institutions, the establishment of personal relationships, and the creation of a memorandum of agreement between TCM and IUPUI.

The Insittutional Blessing

This collaboration was fortunate to have the Dean of Faculties at IUPUI and the CEO of TCM fully behind the collaboration from the start. In fact, both have seen this "case" as a model for future collaboration between the two institutions.

Personal Relationships

The primary collaborators on this project, Dr. Hay of IUPUI and Anne Ray of TCM, developed a meaningful working relationship that swiftly identified common goals and philosophies for the development of a technology-rich exhibit.

Memorandum Of Agreement Between TCM And IUPUI

Finally, and probably most generalizable, is the creation of a memorandum of agreement that indentified the needs of both institutions. The following is a breif overview of the issue articulated within this doucment.

Split of the Virtual and Physical World

For conceptual reasons the exhibit was divided into two parts: the Virtual Environment and the Physical Environment. The Physical Environment includes all physical manifestations of the exhibit: the props, the cabinets, the monitors, computers, cabling, labels, signs, etc. The Virtual Environment includes all of the software that provides the content and the computational tools for the exhibit. TCM IS in charge of the Physical Environment, while IUPUI is in charge of the Virtual Environment. This division of labor will be the cornerstone of the relationship. The following is a list of issues that have been generated and the methods in which they will be handled.

Other Issues

Issue 1. Control of the Exhibits

- Decisions on what exhibits get built (Goals and Content). Hay will enter into the normal negotiation/lobbying process of TCM design team.
- Decisions on what will comprise the exhibit's (Form). Once the exhibit's goals and content have been negotiated within the larger TCM group, the Ray/Hay team will be the primary designers of the exhibit.
- Decisions on changes to the exhibit (Improvement Revisions). Like the previous item, this will be under the control of the Ray/Hay team with advisement for gallery overseers.
- Ability to change exhibit for research purposes (Variation for Research). This will be under the direction of Hay. The Virtual Environment will be directed by Hay with notices given to TCM. The Physical Environment will be directed by Hay working with the Exhibits Dept. of TCM.

Issue 2. Resources.

- Who pays for building exhibits? The Physical Environment will be paid for solely by TCM or through their benefactors. The Virtual Environment will be created by donations of time through sources identified by TCM and Hay.
- Who pays for Improvement Revisions? See Previous Item.
- Who pays for Research Variations? Hay will secure donations of time for research related Virtual Environment variations .
- How should we mutually respect the resources, money, time, and additional people, that each institution brings to the project? All contacts for the Physical Environment resourceswill be

directed to and by Ray. All contacts for the Virtual Environment resourceswill be directed to and by Hay.

Issue 3. External Funding.

- What types of grants should be administered through TCM? TCM should administer grants that will be advantageous to the partnership and will increase the likelihood of success. We see that these types of grants would be primarily grants to develop the Physical Environment.

- What types of grants should be administered through IUPUI? IUPUI should administer grants that will be advantageous to the partnership and will increase the likelihood of success. We see that these types of grants would be primarily grants to develop the Virtual Environment and support research.

- How should the non-administering units be written into the grants? The non-administering party should be written into the grants in such a way as to support the contribution that the non-administering unit will be contributing.

- How should the pursuit of a grant be determined, so as not to undermine existing relationships? This will be a negotiated process between Hay and the TCM's Head of Development Office. Hay will provide a letter that specifies any grant that he is pursuing which involves this relationship. TCM will do likewise.

Issue 4. Research

- What is the appropriate means of data collection? Hay will provide a written proposal to TCM on data collection methods. TCM will provide a written letter of approval of these methods.

- What are the appropriate "human subjects" safeguards that need to be in place from the perspective of IUPUI? TCM? Hay will follow the IUPUI standards on the use of "human subjects" and will provide TCM a copy of the description and forms for this process. TCM will provide a written description and copies of any "Release"-type forms that they require of Hay in conducting this project.

- Who owns the data? All data will be the sole possession of Hay.

- Authorship of publications coming from the studies? Hay will serve as the first author on all publications generated by this research. TCM staff who contribute to the process of conducting the research and/or writing the article, will be included as secondary authors.

- What are TCM's expectations for the research? Hay will provide TCM with copies of articles generated by this research and copies of journals that publish these articles. Hay will also be available for the presentation of research findings to TCM.

Issue 5. Access to TCM

- How do Hay and his associates gain access to exhibits during business hours? during non-business hours? Subpoint Who are the primary contact people in TCM when decisions need to be made in terms of Control of Exhibits? of Resources? of External Funding? of Research?

Issue 6. Ownership of Exhibit.

- Who owns the concept of the Exhibit? There will be joint ownership of the concept of the exhibit. If the exhibit is sold as a whole to other institutions, the proceeds will be divided equitably.

- Who owns the Physical Environment? The actual Physical Environment itself will be owned by TCM.

- Who owns the Virtual Environment? The actual Virtual Environment itself will be owned by Hay and IUPUI per their internal written agreement.

The Effect of the Memorandum of Agreement

The memorandum of agreement was important in a number of significant ways. First, because it was short of a contract which involved lawyers it fostered the emergent and dynamic partnership that was forming between Ms. Ray and Dr. Hay. Second, it was a non-threatening way in which Ms. Ray and Dr. Hay could begin to explore and share the institutional issues and pressures they both live under. In many ways, the partners come from two different worlds The memorandum was a way to negotiate between these two worlds.

The Grand Opening

The Opening of the Science Spectrum Gallery and the Digital Weather Station is scheduled for June 1, 1996. However, our partnership will not end with this event; rather, it will run the life of the exhibit. It is hoped that not only will the many patrons of TCM learn and have fun with the exhibit but also that the exhibit's valuable research will inform future developments to be created. It is hoped that not only

will the many patrons of TCM learn and have fun with the exhibit, but also that the exhibit's research will develop knowledge regarding the design and implementation of informal learning environments.