Designing Across Disciplines: negotiating collaborator interests in a digital museum project

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Abstract

Studies of educational technology projects often describe in detail a software interface and theoretical rationale for the design, and then report on the results of studies conducted using the software. What this presentation explores, however, is another very important aspect of the software development process, namely, the negotiation that takes place when diverse groups come together to collaborate on a common project. This presentation will describe the Global Digital Museum software, and will also examine the unique characteristics of the members of the Global Digital Museum development team and how those characteristics had an impact on the eventual design of the software. Each of these groups has its own understanding of what makes a digital collection educationally useful, and these beliefs had to be accommodated in the final product. The creation of educational electronic environments, especially those that provide access to museum or other institutional collections, require the participation of technical, content/curatorial, design and education professionals. In order for all of the members to be satisfied with the outcome of their development efforts, it is important for each group to try to understand and appreciate the concerns of other groups. It is important to keep in mind that the Global Digital Museum was a research prototype rather than a fully implemented system, although the information gathered about the prototype would be used for further development of digital collection management tools. The prototype was created to test different technical applications for information access and manipulation, such as annotation tools, distributed search engines and user content creation. However, the project illuminated more than the technical possibilities of an integrated museum database. What it also brought to light were the complex challenges that software developers face when different professional cultures intersect.

Introduction

Current approaches to team design practices require careful consideration of the interactions among the various groups that are working to define and develop digital environments. We encourage a framework for design based on a 'social construction of technology' (SCOT) model, which considers important the multiple social perspectives surrounding the development of new technologies (Pinch and Bijker, 1987). System team design perspectives are inadequate when isolated from an understanding of the social and political structure in which they are planned (Kilker and Gay, 1998).

For example, recently our lab conducted a preliminary needs assessment among the key groups involved in producing a large, interactive digital archive of art images. Asked to rate their preferences on system functionality, technical developers, preservationists, and end-users reported widely divergent preference rankings. Technical developers were much more focused on 'pushing the envelope' in terms of software functionality. A successful project, in their eyes, would involve the use of cutting edge applications and programming languages. The preservationists were principally concerned with color fidelity and metadata issues. End-users preferred a large and thorough archive, along with speedy access, easy interfaces and efficient search functions.

From this and other projects we are convinced that professional concerns can have a powerful impact on the goals that development team members construct for the multimedia projects in which they collaborate. We have identified several areas in which the 'big picture' goal differences from the various development team members can require extra, and in some cases even expert, attention. These 'areas of negotiation' can range from minor yet annoying variations in communication goals to large scale show-stoppers. In this paper we address four main categories of concerns—Technical, Disciplinary, Educational and Organizational—that were highly relevant during the design and development of a collaborative prototype called the Global Digital Museum (GDM), a partnership among museum, computer science and design professionals in three different countries. For the sake of brevity, other areas of concern, such as day-to-day managerial issues and cross-cultural differences, which can create major

obstacles to successful collaborations, are not addressed, though they warrant further study. The four categories include:

1. Technical Goals

How technically sophisticated should the program be? Should team members rely on older, more stable technologies, or newer ones that may perform better or provide greater functionality but at the cost of instability?

2. Disciplinary Goals

To which discipline or disciplines do such large-scale project belong? Museum studies, computer science, library science, education and communication each have unique goals and theoretical models.

3. Educational Goals

What kinds of educational approaches and outcomes should the design strive to reach? Is the delivery of multimedia information sufficient or are additional educational tools necessary to meet success? Can research and marketing interests coexist with educational priorities?

4. Organizational Goals

Which legal and administrative practices are in the best interests of the various organizations? Can organizations with different funding patterns construct mutually beneficial goals?

Theoretical Framework

Social Construction of Technology is a theory that evolved out of studies of the sociology of scientific knowledge and the history of technology (Pinch and Bijker, 1987). SCOT theorists are concerned with describing the social processes that characterize technological development, and identifying the social groups who are responsible for shaping technological artifacts (Bijker and Law, 1992). SCOT theorists often begin their analysis with a focus on a single artifact and elaborate on the multiple forces that work together either to bring that artifact into use or prevent the artifact from being accepted. The methodological approach often taken by SCOT theorists is the case study.

When a technology is first created, it goes through a state that the SCOT theorists call interpretive flexibility. This means that the technological artifact is being "culturally constructed and interpreted" as it is being developed, and even as it is being used (Pinch and Bijker, 1987, p.40). Regardless of the explicit intentions of designers and engineers, once a technology enters into the sphere of existence, it can take on multiple meanings for different people and groups of people. "Interpretive flexibility" describes not only how different groups perceive a technology, but how these variable perspectives can have an impact on the actual design of the technological artifact.

In order to understand how a technology is flexibly interpreted, a researcher must identify the relevant social groups, those people, organizations and institutions who play a role in determining the eventual shape the artifact takes. Pinch and Bijker (1987) define a relevant social group as a group whose members "share a set of meanings, attached to a specific artifact" (p. 30). Different relevant social groups can derive very different meanings from a single technology. Those meanings create expectations that can lead to alterations in the design of the artifact and the acceptance of one version of a technology over another. Upon examination of the groups involved in the GDM project, it became clear that there were at least three and sometimes four distinct interpretations of the meaning of the proposed technology, and those interpretations were shaped by the different disciplinary and organizational cultures to which the project participants belonged.

The multiple actors in a technical development project must go through a process of enrolling each other in the enterprise, tailoring the project to meet the different goals of the various actors (Latour, 1987). As this study will show, the goals of the various groups involved in the production of the digital museum prototype were very different, and therefore their interpretations of the project were different as well. An examination of the development process reveals that the interpretive flexibility of this technology was reflected in software design compromises that were made to meets the needs of certain groups.

Latour (1987) describes tactics for translating group interests in order to enroll different groups in a single project. One method is to tailor a project so it addresses the explicit goals of the various groups. However, often this is difficult because the goals of one group may be seen as unnecessary or incompatible with those of another group. Latour suggests that another method for enrolling groups

with different interests is "to link the fate of the claim with so many assembled elements that it resists all trials to break it apart" (p. 122). One way to do this is by creating in those elements the perception of a need for the proposed technology, and for that need to depend on all of the actors working interdependently. The need created in the GDM project was to explore ways of making cultural artifacts, and information about those artifacts, available to a global audience. None of the groups involved in the prototype development could meet this need alone. Each has to rely on the others' expertise for the project as a whole to succeed.

A technology only comes into being if it becomes interesting to groups of people. However, "it is impossible to tell whether these groups have petty interests or broad ones, whether they are open or resolutely closed to technological progress" (Latour 1996, p. 119). An examination of how the prototype developed indicates that the groups have elements of all of these interests and attitudes toward technology.

Case Study: Global Digital Museum

What follows is a case study of a digital database test project in which we were involved, the Global Digital Museum (GDM). We begin with an examination of the unique characteristics of the members of the Global Digital Museum development team. We present our view of how those characteristics had an impact on the eventual design of the software. Each of these groups has its own understanding of what makes a digital collection educationally useful, and these beliefs had to be accommodated in the final product. The creation of educational electronic environments, especially those that provide access to museum or other institutional collections, require the participation of technical, content/curatorial, design and education professionals. In order for all of the members to be satisfied with the outcome of their development efforts, it is essential for each group to try to understand and appreciate the concerns of other groups.

It is important to keep in mind that the Global Digital Museum was a research prototype rather than a fully implemented system, although the information gathered about the prototype would be used for further development of digital collection management tools. The prototype was created to test different technical applications for information access and manipulation, such as annotation tools, distributed search engines and user content creation. However, the project illuminated more than the technical possibilities of an integrated museum database. What it also brought to light were the complex challenges that software developers face when different professional cultures intersect. (See Table 1 for summary of participant differences.)

Group	Field	Concerns	View of Education
Tokyo Research Lab	Computer Science	Testing interactive tools and distributed search engine	Access to tools and resources, user creation of content
National Museum of Ethnography	Museum	Context for artifacts, access to artifacts from participating museums	Thematic integration of diverse artifacts
British Museum	Museum	Context for artifacts, identification with own collection	Making use of expertise of museum education specialists
Human-Computer Interaction Group	Academic/HCI Research and Design	Reconciling needs of different participants, designing intuitive environment	Interactivity, user-centered design, computer-mediated communication

Table 1. GDM Participant differences

GDM Collaborators

IBM Japan Tokyo Research Lab

The idea for the Global Digital Museum was initiated by the Tokyo Research Lab. This group of computer scientists was interested in the technical challenge of creating a common, unified interface for dispersed museum collections, and creating tools that would allow the user to manipulate and annotate the data. Their idea was for the GDM system to serve users as both a public museum and a private museum. In other words, users would have access to public museum collections, but they would also be able to create personal museum collections by selecting and storing the content they found of interest to them.

National Museum of Ethnography (NME), Osaka, Japan

This is a museum that collects common objects from cultures all over the world. Their collection includes items such as clothing, cooking and hunting implements, musical instruments and other objects of every day use. Often the artifacts are in use in the present day. Many of the objects in their collection are not necessarily valuable in and of themselves. Rather, the collection is used to illustrate the cultures that are examined in the museum.

The British Museum, London, England

This museum collection is very different from that of the National Museum of Ethnography. The British Museum contains many priceless objects, such as the Rosetta Stone, classical sculptures, Egyptian sarcophagi and other cultural treasures. Not only are the museum's objects unique, the museum's identity and reputation is strongly linked to its association with these particular objects. Therefore, they are understandably protective of their collection.

Human-Computer Interaction Group, Cornell University

This group, to which the authors belong, has been involved with numerous projects related to the design and evaluation of digital collections for a number of years. Our role in the GDM project was to help create an interface that would make all the functions that the Tokyo research lab was creating easy to use. In addition, we had to take into account the established practices of the member museums, and their concerns about appropriate methods of presentation for their artifacts.

Global Digital Museum Software

The Global Digital Museum is a prototype for a unified system that integrates networked databases of digitized museum artifacts. The GDM user can access the digital collections of participating museums through the use of a common, searchable, browsable interface. In addition, the GDM software gives both the users and the museum content providers considerable power to interact with the electronic materials and create their own work. Through the use of electronic tools, users can annotate content, create their own content, and communicate asynchronously with other users (see Takahashi, et. al. 1998, for more detail description of the GDM software).

It was the responsibility of the interface designers to make this powerful but complicated functionality easy to understand. The challenge was to allow as much user activity and input as possible without confounding the user. Another challenge was to maintain the integrity of the content. One of the main criticisms of hypermedia is that if users do not have adequate background knowledge of a subject area, they can not make appropriate associations. In order to meet the educational aims of the museum curators, it was important to combine flexibility with structure. The software needed to exploit the expertise of the museum curators to guide students and teachers through the content while still enabling individual users to have meaningful and unique experiences.

The exhibits are what make the materials in the databases meaningful. The curators from the two participating museums felt that context had to be an essential element of these digital collections. It would be useless, they felt, for students and teachers who may not be familiar with the cultural artifacts contained in the databases to have access only to individual items. Instead, users would benefit from seeing how items fit into a cultural narrative. An exhibit consists of linked images and text and can be made up of any number of "pages." A single exhibit page shows an image along with descriptive text. Museum curators combine this material to illustrate a cohesive theme supported by the museum objects. In other words the searchable information within the GDM databases consists of mini-stories that describe a collection of cultural artifacts rather than individual items.

As users search or browse through the system, they are able to collect the exhibits in which they are interested by clicking on the "collect" button in the exhibit window. These selected exhibits are sent to a creation space. Accessible from the main navigation bar by clicking on the "Create" button, the creation space allows the user to create a new exhibit, view her "basket" of collected exhibits, or review her works-in-progress. A user can create a new exhibit by combining and annotating the exhibits she has collected, building upon the work of others in the production of new knowledge (Scardamalia, M., & Bereiter, C., 1996).

A user's work-in-progress is stored on the GDM server, but it can only be viewed by the user (defined by her user ID and password) unless she chooses to publish her work. If a user has a work-in-progress open and clicks the "Publish" button at the bottom of the frame, she will be prompted to provide descriptive information about herself and the new exhibit. This information will be used both as a cover page for the exhibit, and as identifying information for searching and browsing. For example, if a creator identifies herself as a student, when another user selects "Student" as her search criteria, this new exhibit will be appear in the search results list. Publishing an exhibit puts it into the main GDM database, making it available to all users. Teachers can browse or search through other teachers' exhibits to see how different people have used the GDM for instruction. Students can look at work created by other students. A teacher can also use the GDM to create a collection of exhibits she can use repeatedly for different classes.

The GDM is designed to allow users to communicate with each other. The ability to publish offers users a one-way version of communication. Because users can collect the work of others and build on that to form new constructions, the exhibits enable diverse users to engage in one kind of collaborative work. However, the GDM also provides users with asynchronous bulletin boards on which they can have threaded conversations with each other. There is an overall GDM bulletin board, accessible from the opening GDM screen, in which users can discuss issues related to the GDM in general. In addition, there are bulletin boards associated with each exhibit. When a user clicks on the "Discuss" button in the exhibit tool bar, an exhibit-level bulletin board opens in a separate window. Here, users can discuss the exhibit associated with that particular bulletin board.

Discipline-based and Technical Goals

How do you reconcile the need of the museum professionals to have some control over the presentation of their artifacts with the need to create a flexible, interactive interface?

The participating museums, particularly The British Museum, were very concerned about the way their artifacts would be presented and used in the GDM system. The museum model for artifact presentation is the exhibit. Museum objects are grouped together by curators in a fashion that provides cohesion by centering around a theme. For example, specific Meso-American artifacts may be grouped in such a way that they tell a story about the meanings associated with Mayan ritual ball games. The museum education professionals involved in the project felt it was important that their artifacts be situated within a coherent context, a context that they created that would make their objects meaningful.

However, the technical group wanted to use the prototype to test out an idea about user manipulation of electronic resources. They wanted users to not only be able to read about the objects in the database, but to be able to annotate them and to choose and store different objects in order to create their own personal artifact collections. These collections could be accessed and used by teachers in order to support their classroom teaching, or by students in order to create projects for their classes. If the artifacts were tied into a specific, pre-determined contextual framework, users would not be able to integrate objects of their choice into their own contextual frameworks.

From a design and technical standpoint, the question that arose was, at what object level can users collect information? Would they be able to collect single images or would they only be able to collect a series of pre-selected images and descriptive text? The HCI Group understood the concerns of the museum professionals, that the artifacts would not be very useful for education if they were stripped of their cultural associations. However, we also understood the technical point of view, that the interface would not be very flexible if users were constrained to only collecting large chunks of data, rather than pieces that could be reconstructed by the user.

The idea of making the artifacts accessible within the context of an exhibit, as opposed to simply a searchable database of digital artifacts, was a form of compromise between the desires of the mu-

seum professionals and those of the technical group. While users are able to collect individual objects, these objects are found within the larger context of what we call the "exhibit." When a user browses the system or conducts a search on, for example, Mayan culture, rather than being presented with a selection of artifacts, she is presented with a selection of exhibits on different aspects of Mayan culture. The exhibits consist of a series of cards, and each card can contain an image and text describing that image. The series of cards can focus on a particular theme, with each card illustrating one aspect of the overall theme. These exhibits are created by museum professionals. The user may collect pieces of the exhibits for personal use, or may choose to collect the entire exhibit. These pieces are sent to the create space (see above) where they can be reconstructed into personal exhibits.

Not only did the issue of exhibits reveal conflicts between museum and technical professionals, but differences between the conceptions the two museum groups had about what would constitute exhibit content also became apparent. The National Museum of Ethnography, for example, was interested in the idea of different museums collaborating in the virtual environment through their objects. In other words, museum curators could have access to a pool of artifacts from all of the participating museums, and these could be incorporated into cross-museum exhibits that focus on specific themes. As noted above, the British Museum, unlike the National Museum of Ethnography, identifies itself strongly with its own specific collections. For this reason, the British Museum was unwilling to make its collections available for other museums to use. While this response is understandable, considering the value and uniqueness of the British Museum's artifacts, from the NME's standpoint, this attitude diminished the potential benefits that such an integrated system could offer participating museums. They believed that one of the main functions of a virtual museum was to enable curators, as well as general users, to do what was not possible in the real world, such as quickly and easily sharing artifacts with other museums.

Another area of contention between the two museums centered around the organization of categories for common search functions. The prototype GDM system initially made use of a standardized list of ethnographic categories that the NME used for organizing its own, real-world collection. Many museums, including the British Museum, shy away from common category and classification systems. NME, on the other hand, saw the need for a basic category system that users could understand in order to search by topic areas. Disputes such as this are ones that participants from design or computer science backgrounds could not predict, let alone resolve, without input from the museum professionals for whom these issues are central. Yet this disciplinary debate has significant design and programming implications. Search and browse functions can not operate without a shared system of metadata.

Educational Goals

These design challenges highlight the fact that different members of the development team had very different conceptions of what constitutes an educational environment. From the point of view of the museum groups, an educational experience was one that took advantage of the expertise of museum professionals to construct a meaningful narrative for the artifacts under study. The British Museum had already created paper resource packs for teachers to use to explore the cultures represented at the museum and to prepare teachers and students for museum visits. These resource packs contained activities designed by the museum education experts. They believed that the GDM should be a digital version of these resource packs.

The curators at the National Museum of Ethnography had already designed their real-world exhibits to focus on specific themes, and therefore wanted to transfer these thematic exhibits into the virtual realm. The Museum's objects had little value except as components of the cultural narratives created by the museum professionals. In addition, the mission of the museum is to educate the public on different topics and cultures rather than to put objects on display. For this reason, they felt the educational potential of this digital environment was that it would give the curators more flexibility in constructing exhibits and it would allow more people to view these exhibits.

From the Tokyo Research Lab's point of view, an educational environment was one that provides users with a common interface that would link multiple museum databases in a single system. Through the use of a powerful, distributed search engine, users could have access to many museum collections. But beyond access, an educational environment is one that allows users to interact with the content. Therefore, they wanted the GDM user to have access to tools that would allow them to manipulate, annotate and create digital resources.

The HCI Group saw the educational value in both building on the expertise of professionals and giving users comprehensive search and resource manipulation tools. As members of the Communication Department of Cornell, we also thought adding a computer-mediated communication component–bulletin boards that allow users to discuss objects and exhibits–would be beneficial. This component was eventually built into the system. However, we also felt that in order to build an educational environment, we needed the input of teachers and students during the development process. Unfortunately, due to time constraints and lack of access to teachers and students, these perspectives were not included in the development process.

Organizational Goals

Because of the diversity of the institutions involved in the GDM development, it is not surprising that the organizational goals of the groups varied. The GDM enterprise brought together not only participants from different discipline cultures, but from different organizational cultures. Though the Tokyo Research Lab has a research mission, as an arm of IBM-Japan, much of its research centers on product development, marketing and distribution. In other words, research prototypes such as the GDM software are geared toward eventual, commercial application. The HCI-Group, as a university-based organization, has a research mission that is more scholarly and less product-oriented in focus. This group was less interested in the eventual product that would be developed than in the process of design, the ideas that would be explored, and the findings that would arise from evaluations of the system. The museums, on the other hand, as not-for-profit institutions, saw their involvement in part of a fund-raising activity, since their involvement in the project was underwritten by IBM-Japan, and in part as a public relations opportunity. Not only would their involvement in the prototype phase of development be seen as progressive and innovative, but their participation in what might eventually become a fully-implemented digital museum system would make their collections accessible to a global audience. However, the public relations potential of this endeavor was at times limited by the museums' concerns over the ownership and integrity of their collections.

The organizational cultures of the different groups influenced aspects of the system development process and the evaluation process. In terms of system development, for example, the concerns that the museums had over copyright issues meant that the artifacts were not digitized and put into exhibits as quickly as other members of the time might have liked. While the Tokyo Research Lab group was often under time pressure to produce a product that contained museum content, the museums were hesitant to make decisions about the electronic distribution of their collections that they might later regret.

These hesitations on the part of the museum, and the time pressures faced by the Tokyo Research Lab also had implications for the evaluation of the system. The Tokyo Research Lab group had to report on its work to IBM-Japan within a certain time period. However, at the time it had to make its report, very little museum content had been entered into the system. Though the HCI-Group was concerned that an evaluation of a GDM prototype that lacked substantial content might not produce meaningful findings, the Tokyo Research Lab chose to go ahead with the evaluation anyway in order to generate some data for an internal IBM-Japan report. While this met the corporate needs of the Tokyo Research Lab, this prevented the HCI-Group from feeling confident that the methodology employed in the evaluation had been rigorous enough to produce findings suitable for scholarly publications.

Reflections on the GDM Development Experience

Working with organizations as large and complex as museums can be a challenge. The fact that the GDM project involved teams from three different countries, and from different professional cultures–the worlds of museums, academia and computer programming–created further challenges. Conceptions of information integrity, technical capability, user involvement, and education varied greatly among the different groups. For example, while the academic researchers believed it was important to involve potential users in the design of the system, museum professionals felt that materials represented as products of the museum should be created by people with museum education expertise and an understanding of the subject matter. In addition, the museum and academic teams often did not fully appreciate the technical difficulties involved in creating a searchable database with servers located half way around the world from each other. Encountering these real-world issues helped us as an academic laboratory to gain a better understanding of the kinds of challenges facing educational technology designers.

The diverse beliefs about design, interactivity and education held by the different members of the

development team had a strong impact on both the design process and final product of the GDM exercise. The software that was eventually developed is a reflection of what the developers believe is useful, appropriate, and, in fact, possible, and the process that took place was one of constant negotiation among members with different backgrounds, strengths and goals. While we as a academic research laboratory would have liked to have seen more user participation in the design and evaluation of the software, we also understand the feelings of the museum professionals who had genuine concerns about involving others in decisions about the way the museum would present itself in a public forum, and the feelings of the programming team who saw GDM as a technical, rather than a procedural, experiment. As a research endeavor, the GDM gave us the opportunity to explore, implement and evaluate various notions about creating collaborative learning environments online. In the process we learned how deeply significant the beliefs and interests of the development team and the eventual users are to they way such environments are constructed.

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