



# Digital image library development in academic environment: designing and testing usability

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## **Abstract**

Case study

### **Purpose**

By reporting the experience gained in the development of a digital image library in academic environment, this paper aims at providing perspective developers with insights on the main usability issues raised by this type of projects.

### **Design/methodology/approach**

The paper addresses three common needs in academia with respect to image collections: preservation, access, and reuse. In the framework of the specific project experience, it discusses how usability issues have been tackled at design time, it highlights the usability problems revealed by tests on the first implemented prototype, and advances proposals on how these problems may be addressed.

### **Findings**

Team formation and high turn-over impact usability design; collection management functionalities effect final product usability; usability and resource reuse levels are severely reduced if the services are limited to those of classic digital libraries.

### **Research limitations/implications**

All usability issues are discussed with respect to the specific project characterised by a small, in-house development team with high turn-over; a participatory design approach; a fairly small, accessible, and heterogeneous user (and stakeholder) population; very limited financial resources but also limited time constraints.

### **Practical implications**

A usability guide for future developers of digital image libraries in academia.

### **Originality/value**

Addressing usability issues related specifically to the design of digital *image* libraries rather than text based digital libraries. Addressing the objectives of image reuse and of widespread adoption. Discussing usability design by a team of students with heterogeneous background in academic environment.

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## **1 Introduction**

### **1.1 Needs and objectives**

The Art History department of the American University of Paris owns a significant collection of slides that professors use for teaching, in conjunction with, and as a complement to regular museum visits, and field trips. In recent years, both faculty and students have begun facing the problems of *preservation*, *access*, and *reuse*.

The *preservation* problem is one faced on many campuses today: traditional slides used to enhance the curriculum are rapidly deteriorating, along with their mounts. Frequent use and handling puts the, often irreplaceable, collections at high-risk. This leads institutions of all sizes to seek methods and solutions that will ensure the preservation of their valuable materials.

The *access* problem, due to the growth of departments, to preservation constraints, and to increasing students (or end-users) expectations, must also be urgently addressed. The very limited availability of slides to professors and students who need to view or manipulate the images for their homework or research is frustrating and inconvenient. Ideal access usually requires possibility of remote use of the resources at any time (24/7).

*Reuse* refers to the ability for professors and students, to re-use images in the digital collection in order to create new sub-collections corresponding to, for example, lectures, or presentations. Obviously, reuse of physical slides presents the problems of time / space constraints (no two professors or students can use the slides at the same time in different places), and the management of a slide-lending library is difficult especially when handling of slides should be kept to a minimum.

### **1.2 Approach**

In order to address these problems the university decided to purchase a professional slide/film scanner and begin to digitize the collection, to store the digital objects in a database, and to make the images accessible through a Web-based interface. The university faced the decision of either acquiring specialized software providing the above services, or developing in-house software. The latter solution was chosen for various reasons. First of all, in-house development would allow customizing the service so that it would respond exactly to the needs of the university as well as forming the basis for further developments and future integration with legacy software (such as regular library services and learning management systems). Second, the development task would provide a very interesting interdisciplinary project within which students and faculty from several departments could interact, collaborate, and experiment. Third, the cost to the university would be significantly reduced.

A participatory design approach was selected for the in-house development project. "Advocates of participatory [...] design emphasize the importance of meaningful end-user participation and influence in all phases of the design process" (Kuhn, 1996, p. 284). This approach had the advantage of involving the main user group (students and faculty of the Art History department) in the development of the system increasing the likelihood of high levels

of adoption and good usability. The two objectives of developing usable systems, and empowering users with respect to the use of new technologies are in fact the ultimate goals of participatory design (Beyer & Holtzblatt, 1995; Ehn, 1992; Kuhn, 1996). Participatory design techniques had also the advantage of creating a natural interdisciplinary, collaborative, learning environment where domain experts (the Art History users) worked together with designers (the Computer Science students and faculty) to build the system.

Making the slide collection available online however, required addressing the issue of copyright management. Access to the slides, in fact, wouldn't be restricted to classroom usage anymore and the collection would become available to a wider audience. Whilst wider availability was one of the goals of the project, control over access had to be addressed to ensure that no copyright protection would be infringed. To explore this core concern faculty and students of the International Communication department were entrusted with the task of analysing current digital copyrights laws and practices in France and the United States (the American University of Paris operates in France but it is registered and accredited in the United States) and in the context of several types of usage with emphasis on academic usage.

### ***1.3 Pedagogical aspects***

One of the objectives of the project was to promote the acquisition of knowledge and skills in several disciplines by all members of the development team which included students and faculty in the Computer Science, Art History, and International Communication departments. The learning objectives included: developing the skills necessary to work in interdisciplinary teams, appreciating the skill necessary to participate in, and manage a large project, learn about the affordances of some of the essential hardware and software components of information systems, learn about the management of art collections, learn about the essential issues in digital assets management, including diverse laws enforced in different countries, and how they apply to different types of use.

A more detailed study of the pedagogical aspects of this project, and an explanation of how participatory system design was used for a constructivist approach to achieving the learning objectives can be found in (Roda, 2004).

### ***1.4 Structure of this paper***

This paper is organized in three parts. The first part discusses how usability issues have been addressed at design time, several design processes are considered, and those decisions that impact overall system usability are analyzed. The second part reports on the usability problems revealed by usability studies on the first implemented prototype of the system. The solutions currently considered in order to address these problems are also introduced. Finally, some conclusions to-date and plans for the work ahead are presented.

## **2 Designing usability**

Usability design was based on several classic techniques. Workshops within the design team and comparative studies of relevant existing systems allowed addressing specific issues including the definition of functional requirements, data requirements, user types, etc. Field observations of the use of slides in Art History classes resulted both in a better appreciation of user needs and in an increased awareness amongst stakeholders of the project. Users interviews (which included questions about the current use of physical slides and the level of confidence with technology) together with results from field observations, allowed the definition of several scenarios for task descriptions. On-paper prototypes and mock-up interactive systems were extensively used to gather fast feedback from sample users and to ensure that the development team had a common understanding of the desired system. This section overviews the main usability issues that were raised at design time.

## 2.1 Usability issues with Project management

When participatory design techniques are applied, *project team formation* may have a significant impact on the usability qualities of the resulting system. This project also required addressing the problem of project maintenance in presence of *high turnover*.

For *project team formation* it was necessary to involve representatives from several stakeholder groups. These included students, professors, IT managers, librarians, and members of the administration. All stakeholders' representatives have been continuously kept informed of the project status through emails and a dedicated Web site where all progress reports have been regularly published. All meetings were kept open to all project participants (no matter how general or specific the agenda was) and individual participation seemed to self-regulate very smoothly with people choosing to participate in those meetings that were relevant to them. The organization of presentations open to the whole university community has been very useful (although time consuming) in order to create awareness, stimulate interest, gather new ideas, and recruit new members for the team. The experience with this project demonstrated that, **in the case of a fairly small, accessible, and heterogeneous stakeholder population, these communication activities, which are often overlooked in IT projects, are vital to the design of products that match stakeholders' expectations and to ensure fast adoption.** Another issue related to team formation is that system design, and consequently user experience, may differ significantly depending on the members of the design team. The project was characterized by a small group of privileged users: the Art History professors. The size of this group was neither small enough to have all members of the group in the design team, nor large enough to involve representatives from sub-groups. In this situation, i.e. **when dealing with small, influential, user groups, an effective approach is to involve those users that are not part of the design team in other activities, such as field observations and interviews.**

The project was characterized by a *high turnover* of the project team's members; in fact, students were mostly working at the project for the duration of one or two semesters (as part of a course project, or an internship) whilst professors have remained throughout the project so far. High turnover requires a frequent "training" of new team members to ensure that they understand the project and its development, and that they integrate smoothly with the team. One obvious solution to the problem has been to create a repository of documents describing project progresses. As the project advanced, the time necessary for bringing new students up to speed increased significantly however, new students were normally assigned more specific responsibilities than those undertaken by students in previous semesters. This greater focus had the advantage of limiting the knowledge that new students needed to acquire about the details of the project development so far. Greater focus also affected usability design. On the one hand, as one may expect, we moved from general usability goals (e.g. simplicity, memorability, consistency, error recovery and prevention) to more specific goals (e.g. only a subset of the metadata should be displayed by default and remaining metadata is accessible on request, default metadata available should be customizable, etc.). On the other hand, more specific responsibilities - such as research on copyrights issues, or design of the interface for database population - allowed students to analyze user tasks from different perspectives often resulting in novel suggestions toward increased usability. **Differently from most standard development projects, in the case of participatory design, under conditions of limited time constraints, a well defined documentation procedure, and as long as a small but influential part of the team remains constant, high turn over in the development team may be an advantage for usability rather than a disadvantage.**

## 2.2 Usability issues with functional and data requirements

The first round of team workshops concentrated on functional and data requirements. At this time two fundamental needs were identified: (1) the system should allow users to store in a database the digital versions of slides and the associated metadata, and (2) users should be offered services for retrieving, through search queries and browsing, the images and the

metadata. This system definition, which corresponds to the definition of a digital image library, guided all the first part of the project. As a prerequisite to these functionalities a scanning procedure had to be defined to ensure preservation of image quality.

One of the main usability issues that emerged early-on in the project, and kept recurring, was the selection, and appropriate naming, of the metadata fields. Whilst the efforts that the team placed in trying to rigorously define these fields was a valuable learning experience and allowed the creation of a shared vocabulary amongst members with different disciplinary backgrounds, the most valuable input for this definition came from a study of existing classifications. In particular, the investigation of classification and metadata fields, which included reviewing several de-facto or official standards (DCMI, 2004; Getty, 2004; Library of Congress, 2004; National Information Standard Organization, 2004), was instrumental in the final decision to chose Dublin Core, and for Art History, a subset of the approved Getty vocabularies for Art and Architecture (Getty, 2004). The selection of this subset was completed by a group of Art History and Computer Science students. The recording of this activity consisted in the definition of the types and names of the metadata database entries however, at the time, a human-readable list of these fields and their descriptions was not generated. This lack of informal record, later caused usability problems for the users of the interface who often misinterpreted the meaning of some of the metadata fields. The lesson learned from this experience is that **in the case of complex or quantitatively large problems (such as the definition of the metadata fields) adapting existing research, standards, or tools is a much more efficient way of tackling the problem. It requires however a very disciplined approach ensuring the recording of the specific interpretations and choices made by the team at the time of analysis and/or at the time of selection of the pre-existing work.**

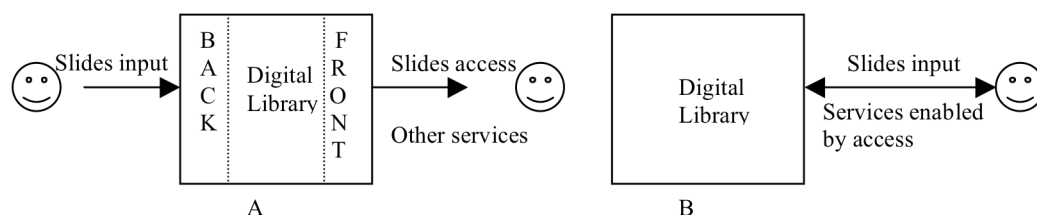


Figure 1 – Digital library mental models

A second usability issue, that was identified and resolved only after the first prototype implementation, was an undetected mismatch between the mental model of a small group of team members (including, amongst others, all of the computer scientists) and the rest of the team. This mismatch reveals the importance of metaphorical system representations, and it is a very good demonstration that reaching an agreement on functional requirements doesn't necessarily imply having a common understanding of the system as a whole. Figure 1 represents the mismatching mental models of the two groups. Figures 1A shows the mental model of the first group who saw the system as a two entrances library, with a back entrance for book delivery and shelving (corresponding to the entering of images in the database), and a front entrance for client to access books (retrieving images), but also for a multitude of other services that had not been formally addressed at the time of the first prototype implementation. Figure 1B shows the conceptual model that the other team members had. In this case, although the library metaphor still holds, only one access point was imagined, it was also assumed that the minimal set of functional requirements defined at the time of the first prototype implementation would have somehow supported functions not formalised yet (see discussion in the section on reuse). Given that all of the computer scientists shared the model 1A, the system design and implementation followed such a conceptual model which was however, both non-explicit, and unknowingly by the team members, non-shared. When the decision was made to develop the first coded prototype by implementing the first functional

requirement (i.e. entering the digital versions of slides and the associated metadata) people with mental model 1B expected that the second requirement (image retrieval) would have been automatically satisfied. This was true to a certain extent (because some minimal search facilities are necessary to support the input process) but users of the back-end system were often disappointed by the minimal *access* capabilities of the prototype. The lesson learned in this case is that **agreed upon functional specifications must be accompanied by the assessment of user's mental models and a conceptual model, including metaphorical definitions, must be also agreed upon if participatory design is to lead to user satisfaction, improved user experience, and ultimately good usability.**

### ***2.3 Usability issues with user types***

Users were categorised as belonging to one of the following four types: (1) university professors (Art History professors in particular) whose main objectives would include storing and retrieving images to create course material, presentations, and sub-collections that would fit their research purposes. (2) Personnel (normally teacher assistants) who would enter the images and metadata in the database on behalf of professors. (3) The university students (Art History students in particular) who would need to retrieve individual images and course materials, and may want to create personal views of the collection. (4) External (not part of the university community) users who would be allowed access to the library.

Whilst all of the above users could be experts or novices to the system, the essential difference in terms of usability design was related to the access rights that these types of users would have. Such access rights had to be regulated in compliance with current copyright laws. For this reason several parallel research projects on copyright law were launched. These included the study of the Fair Use policy as specified in the US Copyright Act 1976 section 107, and the TEACH act from sections 110(1) and 110(2) of the Copyright Act<sup>1</sup>. From these studies the need for the system to identify whether a user is currently enrolled in a course became obvious. In this case, thanks to the TEACH act, he/she would have access to all the images used within that course no matter what their level of copyright protection. One important aspect of access rights is user awareness: users who don't have the right to access an image must be informed of its existence in the database along with the user's limited access rights. This is necessary especially in the case of changing rights (due, for example, to the end of a course or a course session) so as to avoid leaving users wondering why they can no longer find an image they had accessed some time earlier.

### ***2.4 Comparative studies***

The comparative analysis of existing digital image libraries included (BGSU, 2005; Cartography Associates, 2004; Luna Imaging, 2004; New York Public Library, 2004; Virginia Tech, 2004). From this analysis the members of the development team derived a set of usability recommendations which included the following:

- Image thumbnails are very useful for quick reference and they should be well organized into tables with a one or two word metadata caption.
- A help section should be included with search instructions and contact information for a person who could answer questions. Perhaps include an FAQ once the site has been up long enough.
- Make sure the images are reduced to as small a size as possible for online viewing (separate access to higher resolution versions for enlargements and printing). Database sites that are too long to load are practically pointless to use.
- Include a search function on the home page and in a navigation bar on subsequent pages.

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<sup>1</sup> The study of European copyright laws, which seem to be more restrictive in the case of academic use than the US laws, is currently being pursued.

- Include a home button on each page and menus available from every page to avoid using the browser back button.
- Avoid too much scrolling: users should be able to input or retrieve metadata fields without scrolling many pages.

### 3 Testing usability

Usability testing started as soon as the first implemented prototype was completed. As discussed earlier, the first prototype implemented the back-end functionalities (i.e. the data-entry part of the system). Many of the same techniques used to address usability in the design phase (workshops, comparative studies, field observations, user interviews, on-paper prototypes, and mock-up interactive systems) were also used in the testing phase. At this point however, it was possible to have better feedback from users who could also use the implemented prototype. Sessions observing the use of the prototype (by new and experienced users) were organised and users' feedback was elicited through formal and informal interviews. The use of questionnaires, which was also attempted, did not result in significant input because of the small size of the user group for the back-end interface (about 10 people).

Interestingly, because of the mismatching mental models described above, usability testing of the back-end implemented prototype not only revealed this mismatch, but it also provided a much better understanding of users' expectations with respect to the front-end interface. One flow with on-paper or mock up prototypes, experienced in this project, was that users had difficulty distinguishing what parts of the system were not part of the prototype because they couldn't be represented (e.g. users don't see real search results because no database is implemented), and what parts of the system were not there because the designer did not plan to include them in the final product.

The usability study highlighted three major issues with the first prototype. First, not enough *collection management* functions were supplied to ensure the correct input of data and metadata. Second, *customisation of metadata fields' relevance* appeared as a fundamental usability requirement rather than a "nice to have" feature as originally estimated. Third, *image reuse* required a much better support than just accessibility.

The following subsections analyse each one of these usability problems and the envisioned solutions.

#### 3.1 Collection management

The usability study highlighted that efficient collection management should satisfy at least two main requirements. First, from an administrative point of view, it should ensure that the university's property is preserved. Second, given the dynamic nature of the database (images are added, metadata is added and updated) and the heterogeneity of the contributors, it is important to be able to control the reliability and timeliness of the information.

##### 3.1.1 Preservation and image identity

Since the beginning of the project, procedures for scanning the images were defined ensuring that copies were kept both in formats for safe storage and printing, and for video display. The usability study revealed that this preservation effort was not sufficient. Original slides, in fact, were not catalogued as one collection: some of the slides were catalogued as part of the university collection; most of them however, being the property of individual professors, had no associated identifier. This implied that users could not easily associate physical slides with their digital representation, nor could the system have simple identifiers (e.g. the physical slide's catalogue number) ensuring that the database contained no identical duplicates. The issue of image identification is, however, a common problem of digital image libraries. The solution employed by many digital image libraries is to use an arbitrary identifier which often follows a specific syntax, e.g. GIF1234 may identify a gif image,

JPG1234 may identify a jpeg image, etc. (see, for example (University of Virginia Library, 2004)). Whilst some textual resources can easily be compared for equality, and they can often be uniquely identified by fields such as author, title, and date (if not simply through an ISBN), images, such as the ones in the project collection, don't have this property. For example, there are no simple and easily available data that constitute a non-arbitrary<sup>2</sup>, unique identifier for two slides representing the same painting viewed from more or less the same position, in similar light conditions, etc. In order to constitute a non-arbitrary unique identifier, one would need at least the sum of the unique identifier of the painting (e.g. title: "La Gioconda", author: "Leonardo", museum: "Louvre") plus the unique identifier of the slide (e.g. author: "Professor Corel", date: "3/6/2000", time: "15h38'23"). This latter information is frequently not available. In fact, what was originally considered to be a reasonable set of key fields for images identification (title, type, and date of creation) appeared to be an inappropriate choice once the usability tests were started. Figures 2a and 2b show the first two screens of the back-end prototype.

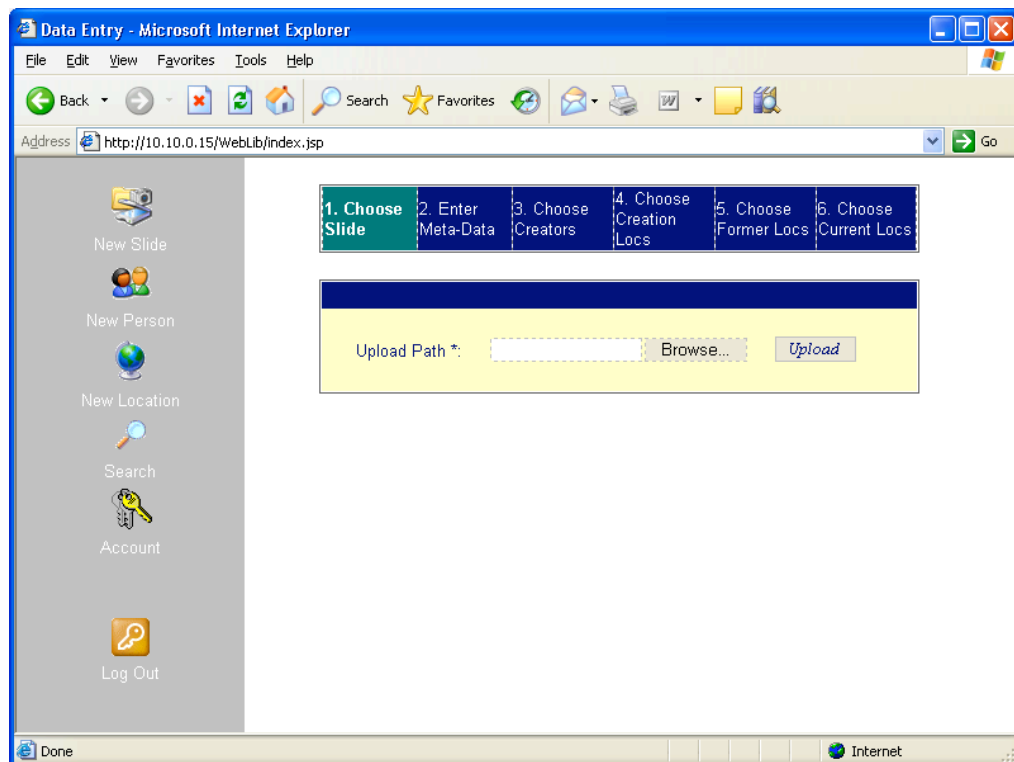


Figure 2a – The first screen of the back-end interface (image file upload)

The users scanning and uploading slides complained that they were forced to enter information they didn't have at hand, for example the title of a particular art piece. Whilst the developers argued that there wasn't much value in the whole project if slides couldn't be searched for, the effective situation was that only a limited amount of information was available. This lack of knowledge about metadata was sometimes simply due to the fact that a student rather than the image owner was inputting the data. In other cases the information was not available or arbitrary (e.g. what is the title of an image representing the third person from the top left in the second column of a given colonnade?). The solution proposed for the former case of data unavailability is described in the next section on the "control of the input process". For the data unavailability problem in the latter case a modification of the interface has been planned so that all input fields can be easily skipped. This solution will also require implementing a flag for images that have been entered without specifying any of a sub-set of metadata fields that constitute a minimal image identifier (this will allow some control over

<sup>2</sup> By non-arbitrary is meant that there exists some semantic relationship between the identifier and the object being identified. An identifier formed by title + author + date, for example is non-arbitrary, a serial number is arbitrary.

extreme cases in which, for example, only an image file has been entered but no metadata field). This flag will be used in the input control process described in the next section. Perhaps the most problematic usability issue caused by difficulties with slide identification was that images were often entered several times with slightly different metadata fields. Whilst a partial solution to the problem is a better control of the input process as described in the next section, the possibility of employing existing software (e.g. (Bolide Software Inc.; NoClone)) to verify the existence of duplicate images in the database is being considered. Amongst other parameters, software compatibility, time requirements, and costs will be evaluated to assess the viability of this solution.

Figure 2b – The second screen of the back-end interface (the only one containing mandatory fields)

One more usability problem, related to the fact that the system had no function allowing users to associate digital images with their physical counterpart (the original slide), was that the frequent requirement to contact the slide owner, or to understand the context in which the slide was produced, could not be satisfied. In order to satisfy this need meta-metadata fields are required which would include information about the slide owner, how the slide was acquired (for example, was it taken by the owner or bought), the date of acquisition, whether the owner was willing to supply further information, etc. Part of this information is also obviously related to copyright issues and the original solution where copyright control was encoded in a system of access control was not sufficient. Users interviews revealed that they would often need to have explicit information allowing them to decide whether certain uses of the images would be legal, or simply correct. Consider, for example, the case of a slide owned and produced by a professor A that shows a panorama and has no access restriction in the database. If a professor B decides to use that image as the cover of her forthcoming book, she needs to contact professor A, if not to avoid breaking the law, at least out of politeness.

Summarising, the above usability issues may be addressed by implementing all of the following:

- An arbitrary image identifier
- Allowing users to skip all fields in the input phase
- Defining a set of minimal image identifiers and a flag system for images not identified.

- Introducing a catalogue system for physical images to take place at the same time as scanning
- Including the metadata fields necessary for the description of the physical image (catalogue number, owner, date of creation, acquisition mode, etc.)
- Integrating existing software for the recognition of exact duplicates of images

### 3.1.2 Control of input process

The slides' input process includes: scanning slides following agreed procedures, and entering images and metadata fields. Data entering is normally performed by teacher assistants. As discussed above, the usability study revealed that this process was much more error prone than expected. Interviews with users highlighted the necessity of a set of services currently under consideration for implementation in the second prototype.

First of all, developers had chosen to use look-up tables for data entry of certain fields such as author and location. The rationale for this choice was to keep data consistent, avoid spelling errors and thus facilitate the search process. However, in the first prototype implementation of the back-end interface, users confronted the inconvenience of having to interrupt the data entry process in case data were missing in the appropriate look-up table. For example, in the screen shot of figure 3, if the image author does appear in the field showing the available persons (toward the top left of the screen, only containing Theo and Vincent Van Gogh's names), users would have to interrupt data entry, click on the *new person* tab, enter the new author using the screen shown in figure 4, and then resume the entering process. In practice, users are expected to first fill in the look up tables and then to start entering the metadata for a new slide. This is obviously not an intuitive approach and it also raises the problem that users normally wouldn't know whether the data is available in the table or not. The solution under consideration for this problem is similar to the one examined for the slide identity problem: allowing users to enter just a minimal set of data for look-up tables (e.g. just an author name, or a location name). This would make it possible for users to enter the data directly in the screen of figure 3 with no context switching. It would however raise the need for a flagging system similar to the one described above for general slide entry.

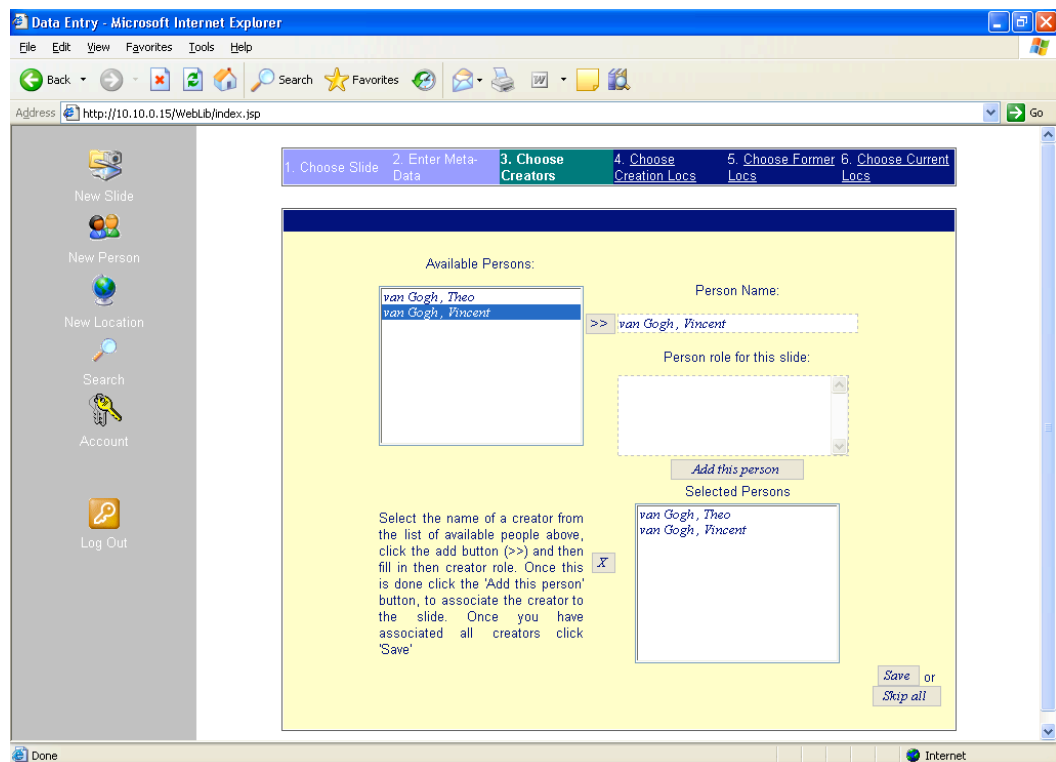


Figure 3 – The user can select or skip screens for metadata entry

Second it seems necessary to institute a system of confirmation for the data entered. For example, by marking as *unconfirmed* all data entered until a data confirmation action is taken by an *editor*. Editors are users with special authorisation to perform confirmation actions (these would normally be professors). Users of the front-end interface would still be able to see *unconfirmed* data but they would be aware that they might contain errors. One of the issues under discussion is whether it would be possible to add a *suggested-editor* field for each image identifying the professor who is most likely to be able to confirm the data for the image. This would allow the system to create a "waiting list" for each editor who would, in this manner, be able to quickly scroll through the images and data waiting for his/her confirmation. This confirmation process would also partially solve the problem (mentioned in the section above) of missing metadata fields unknown to the user who had input the data. The editor in fact would be able to enter the missing data at confirmation time. In the case of flagged images (images with insufficient metadata fields) the editor could decide either to enter the missing data or to remove the image. An editor could not confirm flagged images without supplying a minimal set of identification data.

Figure 4 – New person entering screen

Third, users who performed the input processes often mentioned that it would have been helpful to be able to discuss input procedures with other users performing the same task. A recurrent issue, for example, was the use that others had made of the *date* field. As shown in Figures 2b and 4, dates can be entered in an exact or approximate manner. Often users would have liked to consult each other on the way this field was used in the case of approximate dates. The introduction of both synchronous and asynchronous communication systems for users of the back-end interface may facilitate the task of back-end users.

Fourth, users often expressed the need to retrieve a trace of the input work done by themselves or others (e.g. what is the last slide they had entered? Or, how many slides had been entered by their colleagues?). In order to respond to this need, and also to facilitate debugging, the development team is considering designing a detailed log-book for the system with several levels of accessibility, in order to make visible, for example, a list of the last

slides entered but also a detailed description of the fields entered for a given slide, or how the input process took place (e.g. did the user go back to the same screen several times?)

The confirmation procedure, together with the log-book, and easier communication amongst users of the back-end interface, should help minimise the problem of duplicate slides. Also, it is foreseen that the results of the duplicate finding procedure mentioned earlier will be reported to editors who will decide whether a slide should be deleted or not. With respect to slide deletion and editing (by a non-editor back-end interface user), the same confirmation procedure should be in place, however special cases could be recognised by the system as not needing a confirmation procedure (e.g. a wrong image file has been selected by mistake in the very first phase of the input process and it needs to be deleted, a minor spelling mistake has been corrected in the "additional information" metadata field). The confirmation procedure by editors is obviously a bottleneck for the system and it heavily depends on the willingness of a small group of influential users to take the time to verify and confirm the content of the database.

Finally, no matter how good the user interface is, the data entry process will remain tedious and time consuming. End users are generally happy to be able to search for a piece of art, to browse the collection, to create their own collections, but let someone else fill the database. Thus automatic collection of metadata from different sources like the Web, publicly available collections, or paid archiving services is currently being considered. Obviously the metadata will not match exactly the university's collection however having, for example, a set of predefined authors, locations, and image types would significantly reduce error rates and the time required for metadata input.

### **3.2 Customised access to metadata fields**

The usability study demonstrated that effective access to metadata fields, both when entering information (back-end) or retrieving it (front-end), is key for a digital image repository where the very large number of metadata fields may make scrolling through each one of them very frustrating. For the back-end interface, for example, the initial solution was to force the users to start with the first data entry screen and to move consecutively to the last one, even in cases where there was no data available. The current version allows users to select or skip the screens as appropriate: see figure 3. However, the current solution is still not completely satisfactory. Individual users, in fact, tend to access the same metadata fields and it would be preferable to have the system make this access easier rather than having users repeatedly select the same set of fields. As the usability study proceeded, it became clear that this type of customisation was necessary not only in the case of image use for different disciplinary studies, but also for use within the same discipline to support users' specific objectives. As a consequence, two types of access customizations are currently being considered. They are both based on assigning a relevance factor to sets of metadata fields (e.g. the set of fields defining an author, or a location, or a date). The first type of customization is an attempt to define relevance by discipline, for example *location* and *date* may be more relevant for image searches done by students in political studies, whilst *author* and *type* may be more relevant for art history students. The second type of customization is based on a user model (which may in an initial state take into account the discipline(s) of interest of the user) that keeps track of the fields accessed by the user and allows the system to recognize as most relevant the fields most often accessed. Allowing users to access and modify their user models would also enable them to explicitly indicate which fields are most relevant at any given time, consequently customizing every subsequent input screen sequence, or search result screen.

A further customization issue relates to fields naming. Although currently the project addresses only Art History related fields, field naming was carefully discussed, and a standard fields set was used, users still had problems in understanding the meaning of certain fields' names. To address this problem, the next version of the prototype will include the possibility of visualizing an explanation for each field's name, however, this may not be sufficient in the

case of use within different disciplines. It is foreseen that the extension of the prototype for extensive use in disciplines other than Art History will require the introduction of an ontology system to ensure that relationships amongst concepts with different names are recognized.

### 3.3 Reuse

*Reuse* refers to the ability for professors and students to use images to create new sub-collections corresponding to, for example, lectures, or presentations. In the first analysis it was tacitly assumed that reuse would have been a sort of *derivative* of access. Basically it was assumed that once users had found the images they needed they would naturally organise them, using some other software (e.g. presentation software, learning management systems), in sub-collections. Although this was a very reasonable working assumption because it limited the initial project complexity, it did not correspond to the user's mental model of the system. The mental model most users shared, sketched in figure 1b, was that a set of services enabled by access would actually be provided by the system. For example, users expected to be able to access not only simple slides but also slide collections corresponding, for example, to class presentations; they also expected to be able to recreate class presentations (which normally are run using two slide projectors, one next to the other) directly via the system. These expectations revealed by the usability study are in line with the findings of other researchers. Sumner and Dawe (2001) for example state that "In order for reuse to be successful, a usability line cannot be drawn at the library boundary, but instead must encompass both the library system and the educational resources themselves" (p. 416). Basing their study on research on software reuse they state that "reuse involves three closely intertwined cognitive activities: location, comprehension and modification" (ibid. p. 417). Users must be able to find resources that respond to their needs, they must be able to understand whether the resource is relevant, in which context it has been and can be used, how it is structured, etc. And finally they must be able to modify the resource, which in the case of the project considered here, may mean adding or changing some of the metadata fields, and integrating the resource in a personal sub-collection. The focus then shifts from individual images to collections of images that, in a sense, provide the context for each individual image. Figure 5 shows a screen of a mock-up prototype for this new vision of the system. Each square in the figure represents a collection. Users can search collections (by, for example, *creator* or *subject*), edit them, create new collections by adding images from the database, or view collections (this is done by clicking on the box representing the collection).

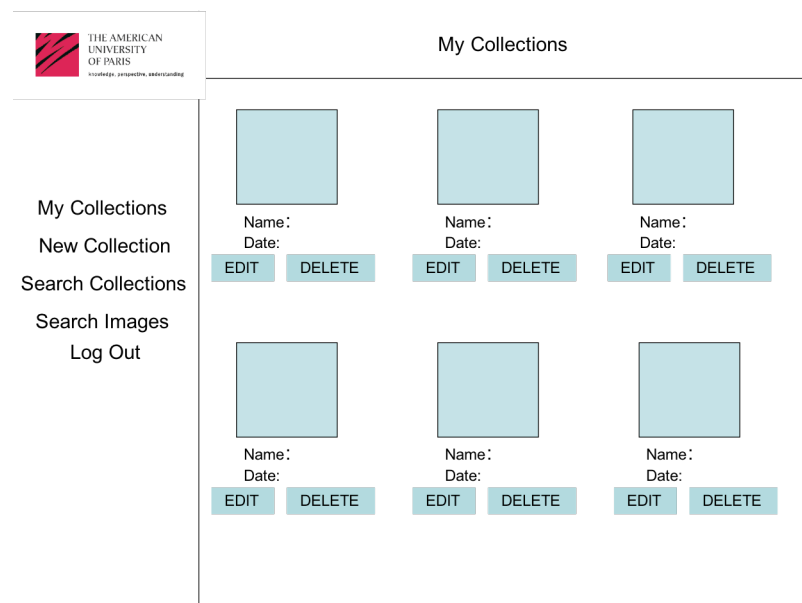


Figure 5 – Shift from individual images to image collections

Because collections are often seen as corresponding to a (class) presentation, the available modes for collection display constitute an important usability factor. Since users were comfortable with the current system of double (or multiple) projectors, the new mock-up prototype implements a system that mimics that structure. Figure 6 shows a screen for collection display. Users can drag and drop slides from the collection (thumbnails on the bottom of the screen) into the main view window(s) in the center of the screen. The number of slides displayed on the screen can be dynamically selected (see top of the screen). The main menu can be hidden to provide better screen view, for example, for in-class display. Clicking on an image will open a separate window giving access to the image metadata. Currently Art History professors prepare for classes by loading the slides they will need in the projector(s) loader(s). This sequence creating activity is not reflected well in the interface proposed in figure 6. Such interface may be better suited for a more unguided discussion where slides are selected as the discussion shapes. In order to allow users to prepare sequences of slides similar to those generated by loading slides in the projector, a second version (see figure 7) of the viewing screen is also being evaluated.

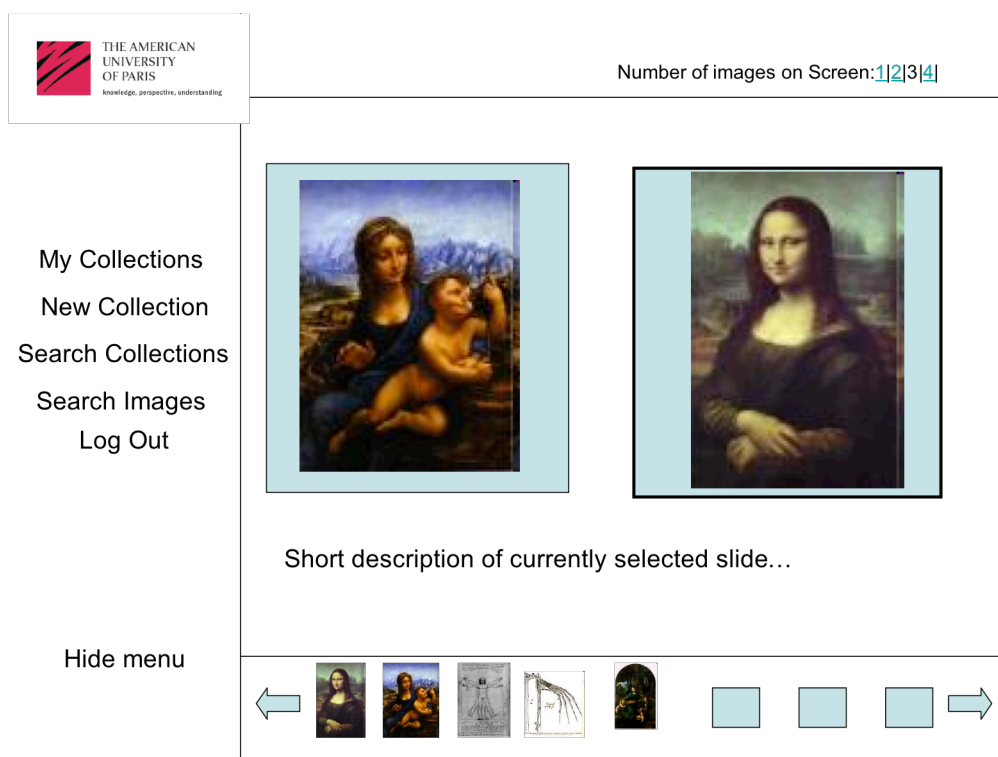


Figure 6 – Displaying a collection

Apart from showing a view with four slides per screen, which could have been achieved also with the display of figure 6, the new version shown by figure 7 is characterized by the fact that view sequences (organized over one, two, three, or four windows) can be defined and associated with a collection. View sequences are created by dragging and dropping slides from the collection (thumbnails on the bottom of the screen) into the sequences associated with each window (thumbnails arranged vertically next to each view window).

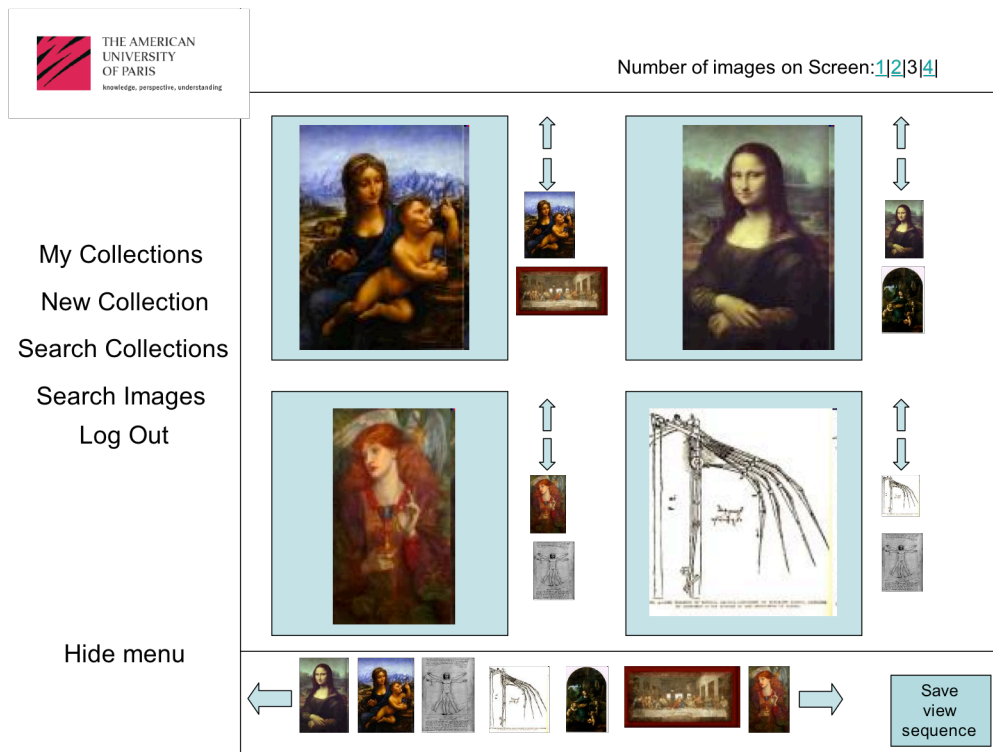



Figure 7 – Alternative collection display screen

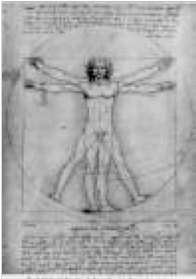

Observing the current use of slides in art history classes not only revealed the importance of image sequencing but it also highlighted the intensive use of slide comparison. Images are continuously related to one another to discuss similarities or differences in styles, use of techniques, and also because of more factual relations. For example, one image may be "part of" another one (e.g. the image of a church and a close up view of its portal), or it may be "next to" another one (e.g. a set of images portraying each person in a painting of the Last Supper), or it may be an "other view of" of the same subject (e.g. two images showing the front and the side of the same statue). All these types of relations, whether they are factual or not, if added to the database, would greatly increase its value. It is currently being studied how such image relations could be dynamically integrated in the database. Other issues related to link creation include: how to manage the selection of images for linking purposes, how to treat bidirectional links, how to make sure that a confirmation process takes place if necessary, and how to allow users to create both public and private relational links amongst slides. Figures 8 show the initial screen for adding links in the mock-up interface.

As stated above, the primary objective was to preserve the Art History slide collection therefore, an Art History image archive was the immediate goal of the project. However, for this archive to make pedagogical sense to the user, images must be treated as only one level or type of informational data, with text supplying further levels of data, linking to multiple images, and complementing and completing the original image accessed. Thus in one sense describing the library as a digital image library is misleading, as textual data must be integrated from the beginning. In future, when other media (the moving images of film or video, for example) are also made available to the user, this early awareness of the necessity to link image and text as equal partners in the archive and practical experience of such symbiotic linking can serve as model.



THE AMERICAN  
UNIVERSITY  
OF PARIS  
knowledge, perspective, understanding

Link Explanation

Select Link type: [?](#)

Detail
Other Angle
Next To
Other

Explanation:

A close up view of the right hands.....

SAVE

Back

My Collections  
New Collection  
Search Collections  
Search Images  
Log Out  
  
Hide menu

Figure 8 – Adding relational links between slides

Overall, supporting reuse has required an augmented digital library that also provides some of the services of a management system for images seen as learning objects. The original main system functionalities: storage and access, must be, for example, integrated by functionalities supporting the organization of class/personal collections, and the definition of relationships between images.

## 4 Future work

Participants began to formulate possible future avenues of development for the project, and to consider what alternatives and provisions might be built into the system to accommodate these developments. Firstly, the repository would be expanded in future to include disciplines other than Art History, such as Cultural Studies, History, International Communications, Film Studies. This would involve further input of metadata, making such metadata available on a selection basis, and the addition of archives of other forms of media than simply still images (video, film, sound, etc., as well as text.) Further usability studies would be needed to make access to such data clear, easy, and efficient; the possibility of integrating several media in future implies that consideration is given from the beginning not simply to supplying easy access to varied media archives for interdisciplinary study, nor even to linking relevant archives clearly, but also to displaying the underlying logic of such links to users from different disciplines with multiple goals (the possible use of ontologies to such end has been mentioned above). For example, an early photograph archive might be variously and simultaneously linked to Art History images and text which demonstrate the impact of photography on painting; clips from early cinema with text discussing the importance and manipulation of light in the creation of an image; a documentary video on early forms of photography; extracts from Benjamin and others on visual consumption, the gaze, and the seeds of contemporary visual culture; essays on the rise of the use of photography in war journalism, advertising, and as propaganda; etc., etc. Such links are often consciously created for specific course sites, but in a digital archive such links should integrate several media unselfconsciously and clearly so that the user may tailor exploration of the archive's metadata to his/her own research and disciplinary demands.

Secondly, issues concerning the future sharing of this digital archive must be considered in more depth in the future and further user research would be demanded. As it is, the user-centred design of a digital archive for The American University of Paris is good preparation for future sharing because of the international and multi-cultural nature of this small university community – but a larger international user community would necessitate further usability study, as Butterworth (2005) has pointed out.

Whatever form this digital resource takes in future, these aspects are certainly to be hoped for: it will never be ‘final’, it will continue to be the valuable learning experience to users/designers that it has already proved to be in its early interdisciplinary development, and it will reinforce the university’s sense of ‘learning community’.

## 5 Conclusions

By describing the experience in the development of a system enabling to preserve and ensure access to a university's slide collection, the following usability issues, raised in various phases of the project, have been discussed. Choices made at the project management level may impact usability quality by enabling stakeholders' involvement, and integration of new team members. Functional and data specifications may result in mismatching mental and conceptual models if metaphorical representations are not considered, and the documentation of such specifications may influence the ability to design a usable system. Copyrights regulations are an important factor in the definition of user types and making these regulations intelligible to users increases usability. Finally in order to meet users expectations, services cannot be limited to those usually offered by digital libraries but such services must be augmented with a set of functionalities supporting collection management and resources reuse.

When the project began in 2004 with Art History, Computer Science, and International Communications students participating, the fact that builders and users were operating within the context of the small community of AUP was identified by all as a major advantage. Group meetings and exchange of information between the participants made it easier to establish preliminary prerequisites and focus on core questions of usability. Knowledge about software, and knowledge about the domain of application – were significantly exercised. Students of all three disciplines were involved in decisions as to metadata, they learned discipline specific vocabularies, and they were made aware that complex copyright issues were a crucial element of end usability. Negotiation of solutions for problems of access which took into account both user ease and convenience (for example, the need for students to access the image database off-campus, modes of allowing restricted access, etc.) and problems of copyright were major issues addressed. Another problem encountered was the need for clarity and simplicity of presentation of information accompanying the images while maintaining a certain complexity of detail and the possibility of access to further background information in the form of text as well as linked images. Therefore all students were of necessity required to participate in decisions as to content, presentation, and design in order to complete their own portion of the project successfully.

Students themselves commented that, apart from their own individual research and learning experiences, they felt the opportunity to understand the demands of different disciplines and how to cooperate across disciplines were the most invaluable lessons of the project.

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