Book: *E-learning and Virtual Science Centers*, Idea Group Publishing, Hershey, USA.
Editor: *Dr. Ramanathan. Subramaniam*, STE, Nanyang Technological University, Singapore.

Personalization Issues for Science Museum Websites and E-learning

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Abstract

E-learning has the potential to be a very personalized experience and can be tailored to the individual involved. So far science museums have yet to tap into this potential to any great extent, partly due to the relative newness of the technology involved and partly due to the expense. This chapter covers some of the speculative efforts that may improve the situation for the future, including the SAGRES project and the *Ingenious* website among other examples. It is hoped that this will be helpful to science museums and centers that are considering the addition of personalization features to their own website. Currently website personalization should be used with caution, but larger organizations should be considering the potential if they have not already started to do so.

Keywords: Accessibility; Digital Collections; E-Learning; Electronic Database; Electronic Resources; Information Access; Internet Access; Internet-Based Technologies; Metadata Creation; Online Community; Online Resources; Personal Use of IT; User Expectations; User Experience; User Interface; User Needs; Virtual Community Building; Web Development; Web Resources; Web-Based Services

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BACKGROUND

In the past few years, the number of people visiting museums' websites has gone up rapidly. As a consequence, museums have to face the significant challenge of creating virtual environments that are progressively more adapted towards the different needs, interests and expectations of their heterogeneous users. Increasingly, museums and science centers are using their website to augment their learning facilities in potentially innovative ways (Hin *et al.*, 2003). In particular, museums need to provide for differing online requirements such as teaching, e-learning and research (Hamma, 2004). One of the solutions available to help is the introduction of personalization techniques (Dolog & Sintek, 2004) that, by providing differentiated access to information and services according to the user's profile, make facilities and applications more relevant and useful for individual users, thus improving the overall visitor's experience. Science museums, by their very technological nature, ought to be at the vanguard of applying new techniques like personalization.

Developed in the early 1990s in an attempt to try to respond to the different needs and characteristics of an ever-growing number of Internet users, personalized or adaptive web systems, have since been exploited in different sectors such as commerce, tourism, education, finance, culture and health. What distinguishes these systems from the traditional static web is the creation of a user model that represents the characteristics of the user, utilizing them in the creation of content and presentations adapted to different individuals (Brusilovsky & Maybury, 2002). By so doing, personalization becomes a useful tool in the selection and filtering of information for the user, facilitating navigation and increasing the speed of access as well as the likelihood that the user's search is successful.

The techniques available to collect information about users, as well as the methods used to process such information to create user profiles and to provide adapted information, are varied. A brief description of the different approaches will be presented here before moving on to illustrate different application examples within the science museum world.

PERSONALIZATION TECHNIQUES

A first important distinction concerning the amount of control the user has on the adaptation process can be made between customization and personalization. *Customization* or *adaptability* occurs when "the user can configure an interface and create a profile manually, adding and removing elements in the profile" (Bonnet, 2002). The control of the look and/or content of the site are explicit and user-driven; i.e., the user is involved actively in the process and has direct control. In *personalization* or *adaptivity*, on the other hand, the user is seen as being passive, or at least somewhat less in control (Bonnet, 2002). Modifications concerning the content or even the structure of a website are performed automatically by the system based on information concerning the user stored in the so-called *user profile*. Such information about the user is provided either *explicitly*, by the user themselves, using online registration forms, questionnaires and reviewing (static profiles) or *implicitly* by recording the navigational behavior and/or preferences of each user through

dynamic profiling web technologies such as *cookies*[1] and *web server log files*[2] (Eirinaki & Vazirgiannis, 2003).

Once the data concerning the users is collected either implicitly or explicitly, or even in both ways, as is often the case, appropriate information that matches the users' need is determined and delivered. This process usually follows one or more of the following techniques: content-based filtering, collaborative filtering, rule-based filtering and web usage mining.

Content-based systems tracks user behavior and preferences, recommending items that are similar to those that users liked in the past (Eirinaki & Vazirgiannis, 2003). *Collaborative filtering* compares a user's tastes with those of others in order to develop a picture of like-minded people. The choice of material is then based on the assumption that this particular user will value information that like-minded people also enjoyed (Bonnet, 2002). The user's tastes are either inferred from their previous actions or else measured directly by asking the user to rate products. Another common technique is *rule-based filtering*, which allows website administrators to specify rules, based on static or dynamic profiles, that are then used to affect the information served to a particular user (Mobascher *et al*., 2000).

Last but not least, there is *web usage mining*, which relies on the application of statistical and data-mining methods based on the web server log data, resulting in a set of useful patterns that indicate users' navigational behaviors. The patterns discovered are then used to provide personalized information to users based on their navigational activity (Eirinaki & Vazirgiannis, 2003).

The information provided to the user through any of the above techniques can be adapted at three different levels: content, navigation and presentation (Brusilowsky & Nejdl, 2004). Adaptive content selection is based mostly on adaptable information retrieval techniques: "when the user searches for relevant information the system can adaptively select and prioritize the most relevant items" (Brusilowsky & Nejdl, 2004). By doing so, the user can obtain results that are more suitable for their knowledge capabilities. Adaptive navigation support is founded mainly on browsing-based access to information: "when the user navigates from one item to the other the system can manipulate the links to guide the user adaptively to most relevant information items" (Brusilowsky & Nejdl, 2004).

Finally, adaptive presentation is based on *adaptive explanation* and *adaptive presence*, which were largely developed in the context of intelligent systems: "when the user gets to a particular page the system can present its content adaptively" (Brusilowsky & Nejdl, 2004). The possibilities of content and presentation adaptability are a relevant element in the reuse of the same resources for different purpose, provided they have been correctly customized in advance. Considering the high cost of personalization, adaptability of resources can also offer an interesting byproduct in term of reuse of the same resources in different contexts, provided that their description is correctly defined through standard metadata applications to allow interoperability of the same service in different environments.

From the perspective of different platform services, adaptability becomes a strategic issue. It could be decided to personalize content for the relatively small screen of

mobile devices, for example. Moreover, if personalization and adaptability on the web is based only on the user, in case of mobile support there is also the need for adaptation with regards to the user's environment (Brusilowsky & Nejdl 2004).

In a museum visit, taking into account the environment where the service will be used can make a notable difference to the experience. For example, an explanation of the items kept in a single room of the exhibition can be offered while the visitor is in that room. There are some projects exploring these opportunities with special regard to mobile devices used by museum learning services (Oppermann & Specht, 1999).

WHY USE PERSONALIZATION IN MUSEUMS?

Even if some of the techniques described in the previous section, especially the more sophisticated ones, are employed mainly on commercial websites, such as Amazon.com, etc., there is already some awareness of the need for their use in cultural institutions, museums, science centers, etc. Personalized access to collections, alerts, agendas, tour proposals and audio guides are just a few examples of the different applications that have recently been developed by museums all over the world (Bowen & Filippini-Fantoni, 2004). The reasons for such an affirmation are numerous, as personalization can help museums respond to various and different needs.

First of all, personalization has the advantage of improving the *usability* of a website by facilitating its navigation and aiding people in finding the desired information. With some knowledge about the user, the system can give specific guidance in its navigation, limiting the visitation space appropriately. The system can supply, or even just suggest, the most important links or content that could be relevant for the user, something that can help prevent them from becoming lost in a website's potentially intricate hyperspace.

Accessibility for the disabled (Bowen, 2004), a specific aspect of usability that concentrates in widening the number of users, can gain from personalization techniques. The ability to select the text foreground or background color, size and font, can make interfaces more easily readable for the partially sighted. A text only view of a website may be easier for such users and also those who are completely blind. For example, the London Science Museum has an option from the home page for a text only version of the website [www.sciencemuseum.org.uk]. The basic content is the same, but the presentation is different. Legislation in the UK, for example, now ensures that learning materials for students in educational establishments, including those provided by university science museums, must be covered by an accessibility strategy (HMSO, 2001).

Personalized systems help to recreate the *human element* that listens to the visitor with understanding by offering an individual touch; this is another important factor that contributes to the success of web personalization in museums. It is a particularly important element, especially for audio-guides, which must offer a certain level of flexibility in order to adapt the contents to the needs and interests of the users, just like a real museum guide would do. It also helps online, making the visitors feel comfortable and oriented in the virtual space, through virtual avatars for example.

Studies indicate that the "social metaphor represented through the presence of personalized animated characters (similar to real life people) can reduce anxiety associated with the use of computers" (Bertoletti *et al*., 2001).

Personalization could also be a useful tool in the creation and development of *online communities* for museums (Beler *et al.*, 2004). In fact, thanks to personalized applications such as alerts, thematic newsletters, customizable calendars and recommendation systems[3], providing tailored content to people with specific interests, museums can identify homogeneous communities of users with the same concerns and needs. Once these different online communities have been identified, it is in the museum's interest to foster them by developing tools and services that aid them in their functioning, especially by stimulating communication. This is when personalization can assist once again. In particular, online forums (Bowen *et al.*, 2003) can benefit from the introduction of personalizing features such as notification of debates or issues that might be of interest to the user, information about other users with interests on specified topics (facilitating the networking between community users), personalized news generation based on personal interests, etc. These kinds of personalized services can increase the value of the underlying museum's "e-community" beyond a social networking environment: "the website becomes an attractive permanent home base for the individual rather than a detached place to go online to socialize or network, thus strengthening the relation between the user and the institution" (Case *et al.*, 2003).

By providing targeted information to users with different profiles and interests, personalized systems are much more likely to satisfy the visitor, who, as a consequence, is stimulated to come back and reuse the system or to encourage other people to try it as well. This is why personalization is also a fundamental *marketing* tool for the development of visitor fidelity, as well as new audiences.

PERSONALIZATION AND LEARNING

Besides helping museums to respond to their usability, marketing and accessibility needs, personalization has much potential when it comes to stimulating learning, as underlined by Brusilovsky (1994) who, early in the development of the web, pointed out how personalization techniques could be an important form of support in education. The reasons for this are varied. First of all, visitor studies seem to confirm that learning is encouraged when the information provided is described in terms that the visitor can understand. Using different terms and concepts, that take into consideration the level of knowledge, age, education of the user, etc., can therefore improve the overall didactic experience. This is precisely what happens with personalized applications where the information delivered to the visitors often changes according to whether they are a child, an adult, a neophyte or an expert.

Research also indicates that learning is facilitated when the information provided makes reference to visitors' "previous knowledge"; that is to say, to what people already know or to concepts already encountered during navigation or exploration (Falk & Dierking, 1992). This suggests that museums should focus on how to activate visitors' prior knowledge if possible. One of the means at their disposal is personalization, which could open new and effective means for long-term learning by

providing adaptive descriptions of artifacts based on objects or concepts that the visitor has already visited or explored. This is, for example, the case in projects like ILEX, Hyperaudio, HIPS and the Marble Museum's Virtual Guide – see Filippini-Fantoni (2003) for descriptions – that, through dynamically generated text, provide personalized information taking into consideration the user's history. The description of the object being viewed or selected can make use of comparisons and contrasts to previously viewed objects or concepts. By providing such coherent and contextualized information, modeled on the user interaction with the exhibition space as well as with the system itself, such applications have enormous potential from the learning point of view.

Another mechanism that can be used to justify the use of personalization to stimulate learning is "subsequent experience" (Falk and Dierking, 1992). A number of researchers have hypothesized that repetition is the major mechanism for retaining memories over a long period of time (Brown & Kulick, 1997). This is why, by allowing the visitor to bookmark objects or concepts of interest during their navigation in the virtual or real environment and to explore them more in detail subsequently (see later for further information), personalization can make it possible to further deepen and continue the learning process from home by creating continuity between the visit and post-visit experiences.

Last but not least, learning is stimulated when a person can pursue their individual interests. Researchers distinguish between "situational interest" and "individual interest", the first being defined as "the stimulus that occurs when one encounters tasks or environments with a certain degree of uncertainty, challenge or novelty" (Csikszentmihalyi & Hermanson, 1995). This is, for example, the case for museums where the presence of incentives like surprise, complexity and ambiguity lead to motivational states that result in curiosity and exploratory behavior (Csikszentmihalyi & Hermanson, 1995).

However this is not enough to guarantee that the visitor is actually stimulated to learn. In order for this to happen, museums have to attempt to respond to their visitors' "individual interests", that is "their preference for certain topics, subject areas or activities" (Hidi, 1990), as the pursuit of individual interests is usually associated with increased knowledge, positive emotions and the intrinsic desire to learn more. Personalizing an educational activity in terms of themes, objects or characters of high prior interest to students, should therefore enhance the overall learning experience. Take, for example, those personalized applications (see later for details) that provide tailor-made visitor plans with consideration of the individual interests of a single visitor or a group of visitors. By suggesting artifacts relating to the visitor's individual curiosity, the visit is more likely to result in fruitful learning activity.

In conclusion, by providing information at the right level of detail, stimulating subsequent experiences and taking into consideration individual interests as well as prior knowledge, personalization represents an excellent tool for all those educators wishing to stimulate and facilitate learning. This is why personalization techniques are often exploited in the creation of *formal* e-learning applications such as long-distance courses that are able to adapt to the student's level of knowledge, cognitive preferences and interests, etc. For example, see the AHA Project on *Adaptive Hypermedia for All* [aha.win.tue.nl] at the Technical University of Eindhoven, The

Netherlands, and the European IST ELENA Project on *Enhanced Learning for Evolutive Neural Architectures* [www.elena-project.org].

However, personalization can be also applied to more *informal* e-learning solutions like the ones that are often available on museums' websites or interactive devices, which, although not being actual lessons, represent very useful educational experiences that contribute to increasing the visitor's knowledge and understanding about a specific issue.[4]

WEB PERSONALIZATION FOR SCIENCE MUSEUMS

Until now, we have discussed more general issues concerning the use of personalization techniques in museums, focusing in particular on its potential to stimulate and facilitate the learning experience. In this section we consider some examples of how science museums in particular are applying these principles online. In fact, even if science museums are not the only cultural institutions to have experimented with personalization both online and on-site in the past few years – for a more general description of personalized applications in museums see Bowen & Filippini-Fantoni (2004) – they are among the ones that have expressed the strongest interest in these techniques. This is because science museums and science centers, whose exhibits are designed to promote playful exploration and discovery of scientific phenomena, have always been relatively aggressive adopters of information technology and innovative approaches; as a consequence, they have also been more eager to experiment with personalization.

Some museums have been focusing more on the usability and marketing aspects of personalization privileging applications such as personalized agendas, alerts and newsletters, which, although having an intrinsic pedagogical value, seem to focus more on promotion. However, science museums have been among the first to understand the real value of personalization as a learning tool, concentrating particularly on stimulating "subsequent experience", "previous knowledge" and "individual interest" in such a way as to explicitly encourage the continuity between the pre-visit, visit and post-visit experiences.

The first examples of web personalization in a museum context were developed in the late 1990s in strict relation with the affirmation of academic research on adaptive hypermedia. Among them (Bowen & Filippini-Fantoni, 2004) was the SAGRES system [sagres.mct.purcs.br], developed in 1999 by the Museum of Sciences and Technology of PUCRS (MCT), Porto Alegre, Brazil.

The SAGRES system (Bertoletti, 1999; Moraes, 1999) is an educational environment that presents the museum's content adapted to the user's characteristics (capacities and preferences). Based on information provided directly by the user or by the teacher (for students), the system determines the group of links appropriate to the user(s) and presents them in a personalized web page.

The principle behind the project was an attempt to overcome the limitations implicit in the one fits all approach and to take the user's individual interests as well as their

level of knowledge into consideration when delivering information, with the aim of improving the overall learning experience. This is possible through an adaptation process that first generates a user model, based on information provided by the user[5]. Once these data about the user have been collected, the adaptation process can select different types of documents conforming to the visitor's model. This results is a dynamically generated HTML page with links pointing to personalized information: the page is created dynamically during the interaction of the user with the system and presents links to the documents, as well as connections to the communication mural (where users can interact with each other), to the document edition, and to the activities the user should perform (in the case of a group visit).

As well as being designed for individual users, the system is particularly meant for use in an educational setting. Through SAGRES, teachers are given the opportunity to define and register their students' profiles, to accompany them and to evaluate their performance during the visit, using reports delivered by the system. At the same time, students are allowed to interchange ideas with colleagues in their groups and to work on the activities and subjects determined by the teacher.

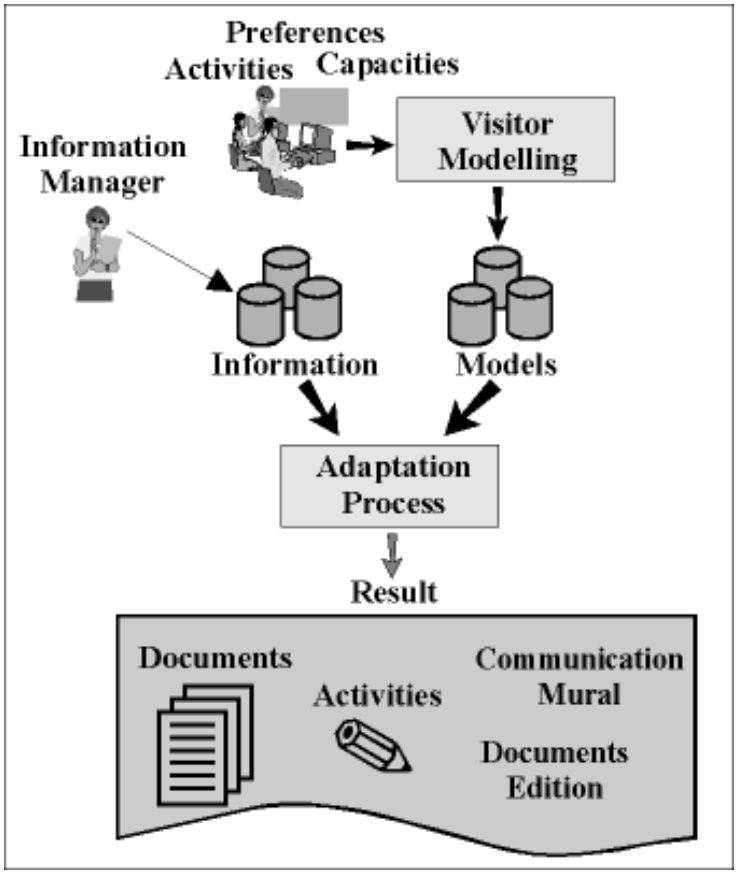

Figure 1. The architecture of the SAGRES system.

PERSONALIZED VIRTUAL WEB SPACES

The main aim of the SAGRES project was to facilitate learning through the provision of information adapted to the level of knowledge and interest of the user. Since then,

other methods have been adopted to guarantee a similar outcome. Various science museums, for example, provide users with tools that allow them to save images, articles, links, search results, forum discussion topics, as well as other types of information during navigation of the website. By doing so, the user creates a personal environment within the museum's website, where they can return, find specific information of interest, and to which new items can be continuously added. This environment can be further equipped with other personalized services such as individual agendas or the ability to send personal e-cards.

Once the page has been created, visitors can log in every time they access the website to find all the information they need. By doing so, the user has the chance not only to find information of interest more easily, but also and especially to strengthen the learning process through reuse and repetition. The learning value of these applications for certain categories of users such as students and teachers is even greater. The personal space can offer teachers the possibility to make suggestions of exhibits for their students to visit and questions that they would like the students to answer during the exploration. In response, the students can save links to the exhibits that most interest them, as well as making short notes both about questions they had at the beginning and about new questions that arise during the exploration.

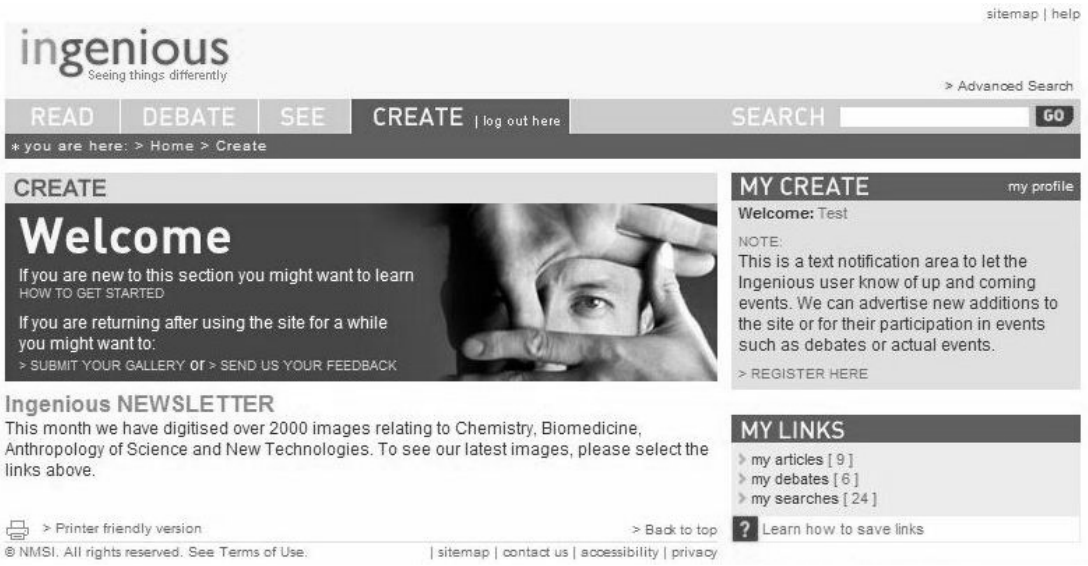

Figure 2. *Ingenious* home page.

One of the most interesting examples of this type of application is provided by the *Ingenious* project, undertaken by the *National Museum of Science and Industry* group in the United Kingdom and funded by the UK New Opportunities Fund (NOF) [www.nmsi.ac.uk/nmsipages/nofdigitise.asp]. This project, online from mid 2004, aims at creating a learning environment for the public from the digitized collections of the Science Museum (London), the National Railway Museum (York) and the National Museum of Photography, Film and Television (Bradford) in the UK. Users of the Ingenious website [www.ingenious.org.uk] can explore and discover the rich collections of these museums through 50 narrative topics and over 30,000 images and other content-rich resources, such as library and object records. In addition visitors are provided with tools for entering a topical debate and personalizing their experience in the so called "CREATE" area, where registered users can save images and/or links

from the debate areas, read sections and search queries. The users can also be send personalized e-cards of images by email and create a personal web gallery from their bookmarked images, including the ability to incorporate personal comments that can be emailed to friends and colleagues.

Figure 2 shows a general shot of the *Ingenious* home page. The facilities include "*My E-cards*" to sent electronic cards (Figure 3), selected hyperlinks (Figure 4), saved images (Figure 5) and web galleries (Figure 6).

Figure 3. *Ingenious* electronic cards.

Figure 4. *Ingenious* selected hyperlinks.

Figure 5. *Ingenious* saved images.

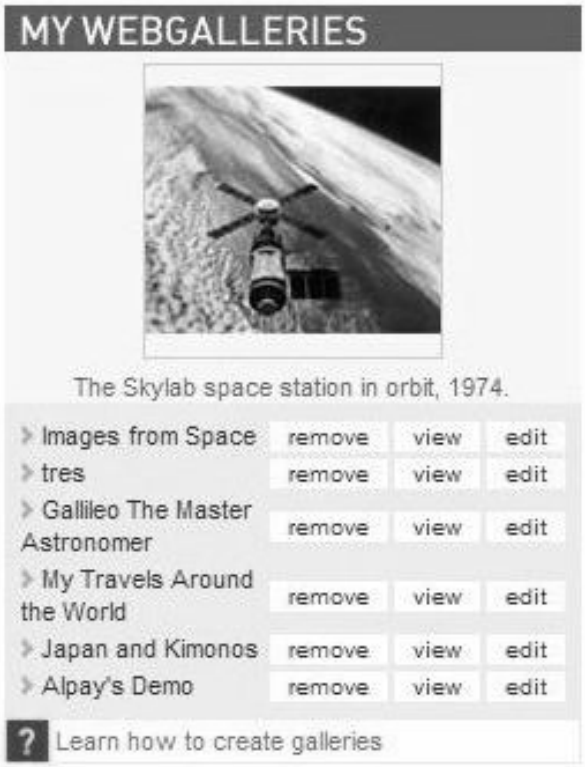

Figure 6. *Ingenious* web galleries.

Even if in the wider picture for *Ingenious* users, the umbrella group is lifelong learners, the application can be particularly suitable for older age school children, teachers, and researchers who could first explore a topic in the "read" or "see" sections of the site, then use the "save image" and e-card features and gradually progress to web gallery tools for creating a personal resource. The web gallery outcome would be used for a project, research, shared among a group of subject enthusiasts or a class (for instance). Community building could follow from this, through the usage of the debate features available on the site.

THE POST-VISIT EXPERIENCE

In some cases, personal virtual spaces can also include information about a visitor's actual visit to museums, thus creating a direct link between the visit and the post-visit experience. Personalization is an effective tool for stimulating visitors at home to follow up on what caught their attention during the exhibition through a museum's website. For example, the London Science Museum's "*In touch*" project allows a record of a visitor's interaction with various exhibits in the Wellcome Wing including an eye scan, voice, face and fingerprint recognition, photo editing, etc., to be recorded using their fingerprint as an identifier, thus avoiding the need for any physical ticket [www.sciencemuseumintouch.org.uk]. The results are made available as part of a personal space within the museum's website, that can be accessed via the visitor's first name and birth date.

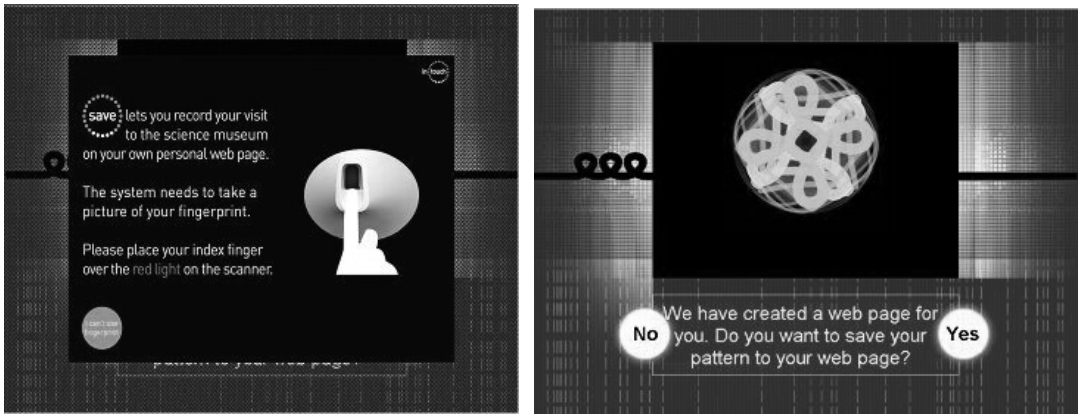

Figure 7. "*In touch*" exhibition screen shots.

Since 2000, when the project was originally implemented, Joe Cutting of the Science Museum reports that (as of January 2004) more than 400,000 web pages have been created, of which around 8% have been accessed at least once. In order to simplify the system, reduce the operational problem that derive from such a large database, and increase the percentage of visitors using it, the museum has decided to replace the fingerprint method (which is not completely reliable in practice) by "an email it to me" option by the end of 2004. Every time a person wants to save one of the interactions, an email address will have to be provided. By doing so, there will be no more automatically generated personal pages for the visitors. However, the museum is considering the inclusion of a link in the email that would allow the visitors to set up a personal page if they wish. In this way only those who are really interested, will set up a page and the museum will not have to maintain a huge and largely unused database. Figure 7 shows two screenshots from the exhibition itself and Figure 8 shows example pages from the associated website.

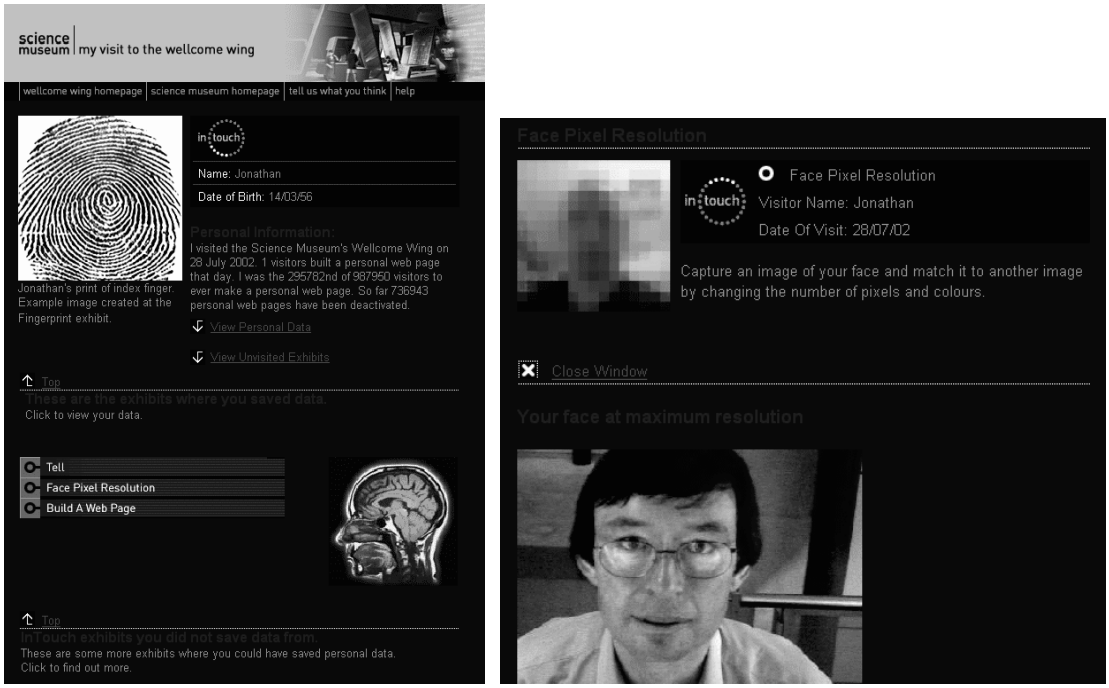

Figure 8. *"In touch"* web pages.

In a similar manner, the *Visite Plus* service offered by the *Cité des Sciences et de l'Industrie* [www.cite-sciences.fr] in Paris, which has been used on a number of successive temporary exhibitions, "*Le Cerveau Intime*", "*Le Canada Vraiment*" and "*Opération Carbone*", allows the visitor to configure a personal profile (with information on preferred language, disabilities, etc.) on an interactive kiosk placed at the beginning of the exhibition through a special bar-coded ticket or on a PDA (Personal Digital Assistant). This data can then be used to access adapted information from the different interactive devices and to play various games and quizzes in the exhibitions. The results of such interaction, as well as the path followed by the visitor, are automatically saved by the *Visite Plus* system on a personal web page, accessible on the museum's website after the visit through the number of the bar-coded ticket or PDA. In this way, the visitor is able to analyze in more depth the subjects that particularly interested them during the exhibition (through the provision of additional information) and to compare results of their interactions with those of other visitors.

The fact that an important part of the content concerning the exhibition is accessible after the actual visit, at home or in another context, allows the visitor to focus more on experimentation and discovery while in the museum and to leave the more traditional didactic aspects for later. The *Visite Plus* system also offers the possibility of subscribing to a personalized periodical newsletter that focuses on a series of themes selected by the visitor at the moment of the registration. Options include selecting from a list of available subjects or receiving a complete dossier of the exhibition. See Figure 9 for an example of the view of the exhibit from the personalized website. Each square corresponds to a content area in the exhibition. The squares that are in full color represent the ones that have been accessed during the visit to the exhibition while the white ones correspond to the ones that have not been visited.

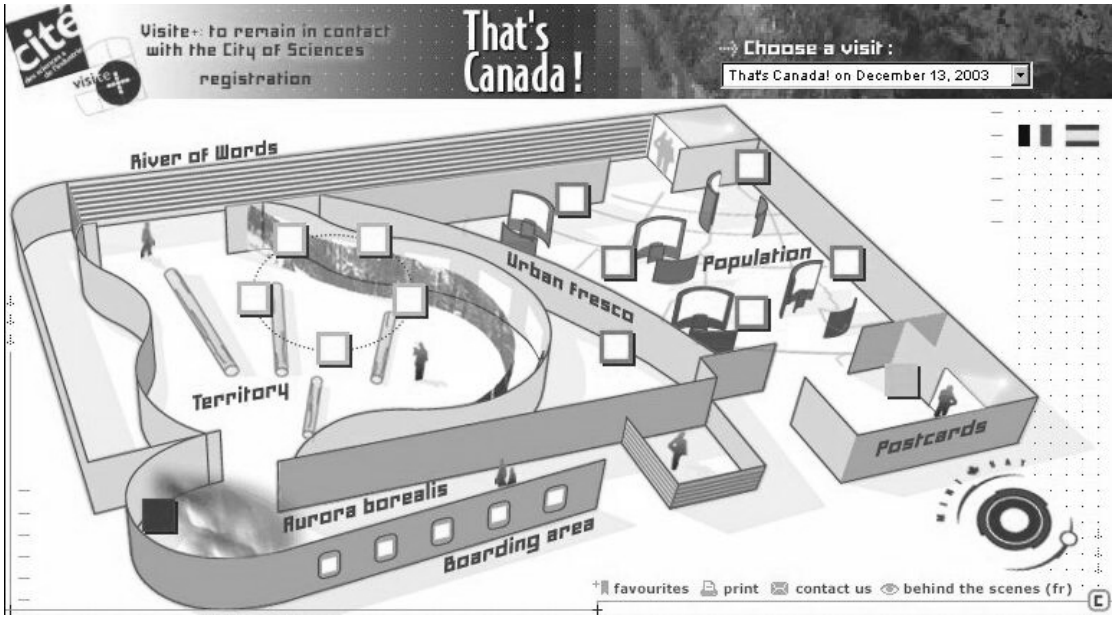

Figure 9. *Visite Plus* personalized website.

Similar concepts have been introduced and tested in the framework of the *Electronic Guidebook Research Project* [www.exploratorium.edu/guidebook], which began in 1998 at the San Francisco *Exploratorium* in California, in partnership with Hewlett-Packard Laboratories and the Concord Consortium. This is aimed at developing a roving resource to enhance a visitor's experience at the museum (Hsi, 2003). In particular, the purpose of the project is to investigate how a mobile computing infrastructure enables museum visitors to create their own "guide" to the Exploratorium, using a personalized interactive system. This helps in better planning of their visit, getting the most out of it while they are in the museum, and enabling reference back to it once they have returned to their home or classroom. The guidebook allows users to construct a record of their visit by bookmarking exhibit content, taking digital pictures from a camera near the exhibit, and accessing this information later on a personal "MyExploratorium" web page in the museum or after their visit (Figure 10).

The project was designed as a proof of concept study to explore potential avenues for future research and development and therefore was not envisioned to support the implementation of a fully functional system. Nevertheless, the tests that have been run so far revealed interesting conclusions. Above all, the visitors liked the idea of being able to bookmark information for later reference. Both teachers and pupils thought this feature would allow the children to play more during their museum visit, completing related homework assignments after the visit (Semper & Spasojevic, 2002).

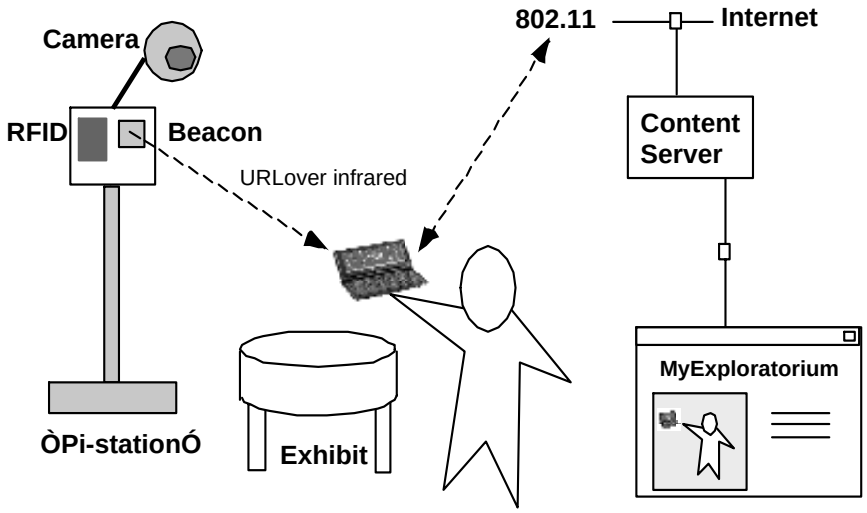

Figure 10. *MyExploratorium* set-up.

THE PRE-VISIT EXPERIENCE

The link between visit and post-visit experience can be also extended to the pre-visit phase through the implementation of systems that allow visitors to create personalized tours based on their interests and needs. Most museum visitors, even those who have not visited before, arrive with expectations about what will happen during the visit. Such hopes might concern specific subjects of interest that the person wants to explore, the physical characteristics of the museum, the types of activities that can be undertaken or the social context in which the exploration takes place (alone, as a family, within a larger organized group, etc.). All these factors merge to create a visitor's *personal agenda* (Falk & Dierking, 1992). The success of the museum experience is partially defined by how well it corresponds to the visitor's personal agenda.

Personalization is a useful tool to create such a correlation because it helps a visitor to find out what, within the museum, could fit better with their personal agenda or correspond more to their expectations. This can be done either from home on the museum's website or directly onsite through interactive devices available in the museum**.** Upon completing a profile, where the intending visitor must indicate different types of information such as how and when they are tentatively planning to visit, with whom, how long they plan to stay, what sort of interest(s) they have and which language they understand, the system will be able to provide a personalized plan for the visit that takes the submitted information into consideration. Personalized museum plans can be very useful, especially for large museums where visitors are likely to be overwhelmed by the number of objects or exhibits available for viewing during a single visit. In such a context, visitors are often disoriented and find it difficult to decide what they want to see or do. Answering a few very simple questions, or defining a few criteria, can help them to overcome these limitations, enjoy the visit more fully and learn more easily.

A number of museums are working on developing online and onsite applications based on these principles. The *National Museum of Ethnology* in Leiden, the Netherlands [www.rmv.nl], for example, has developed an onsite facility called *"The*

tour of the world in 80 questions" that allows children aged 7 to 13 to print out a personalized tour plan of the museum based on an individual choice of subjects and continents. The tour plan, which is colorful and easy to understand for children, includes a series of maps that help locate the objects, a brief description of the artifacts and a list of questions related to the subjects chosen, which the young visitors need to answer during their museum exploration.

The *Cité des Sciences et de L'Industrie* in Paris is undertaking a project called *"Navigateur"* (Navigator), which will allow visitors to create a personalized tour based on an individual choice amid a set of criteria which include the context of the visit (alone, family, group), the language spoken, the particular interests, the time available and the type of experience desired. Once the visitor has set the criteria that are most relevant for them and has checked the offerings on the museum interactive plan, the personalized proposal can be saved on the museum bar-coded ticket, which will be used during the actual visit, when using different interactive devices throughout the museum, to obtain further assistance in finding the recommended exhibits or to reset the criteria based on new interests that might have arisen during exploration. The system will be linked directly with Visit Plus, thus creating continuity between the pre-visit, actual visit and post-visit experience, through the use of personalization.

CONCLUSIONS

The examples provided here from different science museums all over the world help to prove the potential role that personalization could play in strengthening the overall learning process before, during and after the actual visit, in advance through activities that orient visitors and afterwards through opportunities to continue reflection and explore related ideas. However, despite the obvious potential benefits that these applications can bring to the visitor's experiences, there is still very little evidence that these systems work in the terms envisaged by their promoters, especially with respect to learning. This is because, due to their relatively recent nature, most of these projects have not yet been subjected to thorough evaluations that focus on establishing, among other things, the long-lasting effects of personalization on the learning process. Until now, the very few evaluations that have been carried out have focused mainly on whether people use the systems or not, why they do so, where they encounter most difficulties and on their usability in general. Despite the fact that further studies are needed in order to shed light on the effectiveness of personalization as a pedagogical tool, the first evaluations of these early examples, as well as other similar projects, have given initial help in indicating various pros and cons related to their use.

The overall feedback concerning the introduction of personalizing applications to audio guides and virtual environments seems to be reasonably positive: visitors are spending more time in the virtual and real museum, they access information at the level of detail desired and appreciate the idea of being able to bookmark information for reference later (Semper & Spasojevic, 2002). In particular, a study by Cordoba & Lepper (1996) has evaluated the consequences of personalization with respect to stimulating intrinsic motivation and learning in a computer-based educational environment. The findings provide strong evidence that the students for whom the

learning contexts had been personalized, through the incorporation of incidental individualized information about their backgrounds and interests, displayed better gains in motivation, involvement and learning than their counterparts for whom the contexts had not been personalized.

However some drawbacks have also emerged[6]. First of all, there are the issues related to the difficulty and expense of implementation and also problems in practical use by visitors[7]. So far it seems that only a limited number of visitors take advantage of the benefits available through personalization, partly because the systems are not implemented in a clear and easy manner and partly because most visitors are either not ready for technology or not willing to invest time in it. Therefore it is important to remember that personalization should not be implemented for the sake of it but when and because it brings added value to the museum for, if not all, a good percentage of visitors. Only if this occurs can the costs for investment and development be justified.

Some experts have warned against the use of personalization. Nielson (1998) has argued that personalization is over-rated, saying that good basic web navigation is much more important. For example, it is helpful to consider different classes of use in the main home page, such as physical visitors, the disabled, children, teachers, researchers, groups, etc., and to give each of these a relevant view of the resources that are available (Bowen & Bowen, 2000). Such usability issues are certainly important, and relatively cheap to address with good design, but even Nielson admits that there are special cases were personalization is useful.

More recently, there have been further questions about the effectiveness of personalization (Festa, 2003; McGovern, 2003), despite the enthusiasm of some. For example, the costs may be up to four times that of a normal website, around a quarter of users may actually avoid personalized websites due to privacy concerns and only 8% are encouraged to revisit because of personalized facilities (Jupiter Research, 2003). This compares with 54% who considered fast-loading pages and 52% who rate better navigation as being important. However, other surveys indicate that personalization can be effective, for example in the field of downloadable music (Tam & Ho, 2003).

Another issue that needs to be stressed in personalization is related to standardization procedures and applications. This process is central both for content description and user profile definition using metadata (Conlan *et al.*, 2002). The description process can however be very time-consuming and expensive, but if it is pursued properly it allows the resources to be reused for different purposes and a visitor profile to be created using various different sources of information following evaluation criteria. Museums are sometimes not very quick in adopting new technologies but in some cases the slow perspective allows them to make the most of other institutions initial mistakes and thus to avoid them. Involvement with standards provides a good opportunity to share such knowledge.

Thus it is recommended for museums to use personalization on websites judiciously at the moment, although science museums with good funding may wish to be more adventurous. There is a place for personalization in leading edge websites and for certain innovative facilities like advanced web support for specific exhibits. It is an area that museums should certainly consider, but the costs should be weighed against

the benefits. Of course, the costs are likely to decrease as commercial and open source support improves in this area. At the moment, not insignificant development effort is needed for such facilities, but in the future they could be increasingly packaged with standard database-oriented web support software, such as content management systems, as understanding of what is useful and not useful is gained from practical experience. This is certainly an interesting and fast-moving area that should be monitored by innovative science museums, especially at a national level.

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Silvia Filippini Fantoni is a research student at the Sorbonne University in Paris, where she is working on her PhD about *Personalisation through IT in museums*. She graduated in contemporary history from the University of Milan and has experience in working as a researcher at the European Centre for Digital Communication (Heerlen, Netherlands), the McLuhan Institute (Maastricht, Netherlands) and the Louvre Museum (Paris, France), where she focused on developing personalization applications for the new website. The results of work carried out so far have been presented at international conferences and seminars (EVA, ICHIM, Museums and the Web), where positive contributions towards the hypothesis have already been received and have led to interesting collaborations with Dédale on a European Union study about *Cultural Institutions as New Learning Environments*, La Cité des Sciences et de l'Industrie in Paris and the Canadian Heritage Information Network (CHIN).

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Endnotes

[1] A “cookie” is a small piece of data sent by a website and stored on the client-side (browser) computer that can be reused later on the server-side (the website that sent the cookie) as unique information concerning a user.

[2] A web server log is a record of each access to a web server with information such as the name of the client computer, the date/time and the resource accessed.

[3] These applications are currently available on a number of different museums’ websites such as the Metropolitan Museum of Art, the Whitney Museum of American art, etc. For a detailed description of these applications, see Bowen & Filippini-Fantoni (2004).

[4] Please note that the distinction between *formal* and *informal* education is used here in a rather loose sense. Usually, in the educational sector, classrooms are considered formal learning settings, while museums are considered informal learning settings. As an alternative, we propose here to use the term formal e-learning tools in relation to proper courses meant for students who cannot attend classes; while by informal e-learning tools we refer to online or onsite educational environments.

[5] Note that the acquisition of knowledge about the visitor is done in an explicit way: information is directly extracted, through the filling of forms, with direct answers to questionnaires. SAGRES works with two kinds of models: individual model and group model. The group model is built by the teacher and used by students. The teacher is responsible for the definition of the students’ characteristics, by the definition of the group stereotype (subject, knowledge level and language of the consultation), the activities stereotypes and the classes (name of the students presented in the group).

[6] It is not the intention of this chapter to be negative towards the use of personalization techniques in museums, but to constructively highlight some of the questions that come to light when the social uses and design problems are considered.

[7] For more detailed information on the problems related to the implementation and use of personalization techniques see Filippini-Fantoni (2003).