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Enjeux des instruments de perception et de pratique dans les programmes éducatifs du monde numérique

**Nancy Proctor, Smithsonian American Art Museum (Etats-Unis)
Stephan Schwan, IWM/KMRC, Tübingen (Allemagne)
Vincent Maestracci, Inspection Générale / Ministère de l'Education
Nationale**

***New Technologies for Learning in Museums: An Interdisciplinary Research Project* d' Eva M. Reussner, Stephan Schwan et Carmen Zahn, Knowledge Media Research Center (IWM/KMRC) en Allemagne. In J. Trant, & D. Bearman (Eds.), *Proceedings of the International Cultural Heritage Informatics Meeting (ICHIM07)*. Toronto, Canada: Archives & Museum Informatics, 2007.**

Introduction

In modern information and knowledge societies, knowledge acquisition is not limited to formal educational institutions such as schools or universities. Information provision in the mass media, the internet and out-of-school environments such as museums and exhibitions play an increasingly important role for life-long learning. The contribution of museums to public education has repeatedly been emphasized in recent discussions about the need to raise the level of understanding of actual concepts, findings and methods of the sciences and the humanities in society and to increase the public's engagement and involvement with scientific issues. These aims are labeled "Public Understanding of Science and Humanities", "Public Understanding of Research" and "Science in Society" (Durant, 2001). In executing their educational function museums use a number of different media for interpretation in exhibitions, ranging from classical text panels to the newest digital technologies. Through dynamic aspects, immersive elements and new forms of user adaptation and interaction digital technologies can contribute to the further development of interpretation practice in

museums. But so far research on the educational potential of new technologies in museum exhibitions has been scarce.

The project "Learning in the museum: the role of digital media" seeks to bridge this gap in exploring how different forms of media can best support learning in science and technology exhibitions. The project runs from January 2006 to December 2008. It is funded by the German Government and the Federal States (German "Laender") in the context of the "Pact for Innovation and Research" initiative. Project partners are the Knowledge Media Research Center (IWM/KMRC) in Tübingen, the Deutsches Museum Munich and the Leibniz Institute for Science Education (IPN) at the University of Kiel. All three institutions are members of the Leibniz Association, a scientific organisation comprised of 84 non-university research institutes and service facilities in Germany.

Each of the three partner institutions brings its own distinctive perspective to the project: The Knowledge Media Research Center is concerned with the investigation of knowledge acquisition and knowledge exchange with digital educational and communication media, the Deutsches Museum represents science and technology museums in terms of the application context of the research, and the Leibniz Institute for Science Education contributes a pedagogical research perspective. As we integrate these different approaches we hope to derive a more complete and comprehensive picture of visitors' use of and learning from digital media in museums.

The interdisciplinary project is further characterized by its theoretical foundation in psychological models of learning, the acknowledgement of museums as complex information environments, an emphasis on innovative digital media and user centered design principles and the use of a broad range of empirical methods combining both field and laboratory studies that go beyond the established method repertoire of visitor studies and allow more specific research questions. By developing prototypical implementations of media for exhibitions the project cultivates a close connection between research and practice. According to the paradigm of use-inspired basic research (Stokes, 1999; Fischer et al., 2003), the questions investigated and the results produced by the project are expected to contribute to a better understanding of learning processes in museum exhibitions. In addition, the findings allow deriving recommendations about how exhibitions and especially digital media elements can be evaluated, advanced and optimized with regard to their learning potentials.

In the following paragraphs, the research program of the project "Learning in the museum: the role of digital media" is outlined. First, the current use of digital media in museums and the role of museums as places of learning are described as research background. Then, the theoretical approaches are explicated. Finally, an overview of the concrete investigations is given.

Digital Media in Museums

A survey of current media applications in museum exhibitions undertaken as part of the research project has shown that the use of digital media in museum exhibitions combines *digital technologies* offering novel forms of perception and interaction with innovative *usage principles* prominent in recent developments such as Web 2.0. Museums increasingly make use of a range of digital media ranging from mobile devices, transparent touch screens, augmented reality installations and interactive tables to virtual reality representations and auto-stereoscopic displays for 3D visualization. These implementations allow a self-directed location-based information retrieval, a more direct visual connection between exhibit and contextual information, novel and more intuitive ways of interaction as well as immersive scenarios.

In addition, innovative usage principles are applied that can be described with keywords such as active participation, collaboration, storytelling as well as personalization and adaptation. Practical applications include for example opinion and discussion terminals, digital authoring tools, possibilities for emailing links and information for later reference, the use of personal stories and narrative elements to convey information in a more emotional way, the provision of interest-based mobile devices, and finally platforms for knowledge exchange and collaboration between visitors. These

kinds of implementations allow museum visitors to select content adapted to their individual preferences, information needs, interests and goals, to contribute content, and to share information and opinions with others. The transfer of these principles to the museum realm implies an empowerment of the visitor that challenges the classical expert-novice relationship between curators and visitors.

The introduction of these innovative principles and technologies in exhibitions contributes to the further development of interpretation practice in museums. But in what way do they possess the potential to contribute to learning experiences? It is one major aim of the research presented here to relate different applications of digital media to learning concepts derived from psychology, in contrast to classical approaches merely categorizing them by different technological aspects. As a background to the problem of the educational potentials of digital media in museum exhibitions, the role of museums as learning environments is discussed next.

Museums: Places of Learning

Whereas museums cannot exclusively be seen as places *for* learning, they have nevertheless a visible tradition as places *of* learning. North-American museums are understood to be educational since their very inception, whereas European museums are said to deserve this attribute since the second half of the 19th century (Roberts, 1997). The 1970s brought a renewed and more professional emphasis on the museums' educational role in the context of a democratic demand for more participation, access and inclusion. For example, in 1973, the Standing Professional Committee on Museum Education was founded as a special interest group within the American Association of Museums. But it was not until the 1980s that educators started to be taken for granted as part of museums' staffs. Today, education is acknowledged as one of the core functions of museums, complementing the classical duties of collecting, preserving, exhibiting and interpreting together with functions such as service delivery, marketing and public relations, fundraising, event management, and evaluation.

Museums are places of learning not only in their own understanding. Also from the perspective of visitors, learning is a type of experience they expect and even seek to have in a museum, as studies undertaken at the Smithsonian Institution have shown (Pekarik et al., 1999). The research yielded a list of fourteen experiences visitors find most satisfying in museums, grouped into four categories: object experiences (e.g. seeing the "real thing"), introspective experiences (e.g. recalling memories), social experiences (e.g. spending time with family), and cognitive experiences (e.g. enriching one's understanding). These different types of experience are not to the same extent provided by different kinds of exhibitions, and they are not to the same extent sought by different visitors. What could be shown, however, is that cognitive experiences, together with object experiences, are those found most satisfying by visitors across exhibitions? The place of museums in the leisure and tourism industry being acknowledged today, it is evident that learning is not a contradiction to but an important element of a free-choice museum experience.

The heterogeneity of visitors with a broad spectrum of individual prerequisites and preferences is one hardly predictable ingredient of the learning experience in exhibitions. On-site, these learning experiences are triggered by the materials arranged in the museum space, requiring an exploration by movement. Exhibitions provide a complex texture of objects, classical media, digital media, interactive elements and exhibition architecture that are interwoven both spatially and conceptually. The order and extent of their reception by the visitors cannot be prescribed. It depends not only on the exhibition structure but also on the pace, choice, interest, attention and energy of the visitors who do not always follow the intended visiting paths. Another point to recognize is that visitors seldom come to the museum alone but are usually accompanied by a partner, family members or peers. The social interaction between them is another factor to consider when examining learning experiences in museums.

These different elements impacting on the learning experience are taken into account in key publications relating to learning in museums that appeared around the turn of the millennium (Hein, 1998; Falk & Dierking, 2000). In acknowledging the complex nature of the learning process as an interplay between the physical environment of an exhibition and the visitor's personal prerequisites

and the social context of the visit (Falk & Dierking, 2000) as well as in taking a constructivist stance (Hein, 1998), these authors underline a shift in emphasis from the educational intentions of the museum to learning processes on the part of visitors, occurring during the visiting experience. Accordingly, terminology has moved away from the notion of education to concepts such as learning, meaning-making and the visitor experience in more general terms (Roberts, 1997). In line with these developments also the understanding of the term learning itself has broadened. Studies such as those related to the British “Inspiring Learning for All” initiative started by the Department of Culture Media and Sport (DCMS) in October 2000 (Hooper-Greenhill et al., 2003) enlarged the understanding of what can and should be counted as learning in museums. A set of generic learning outcomes was empirically developed and grouped into the categories knowledge and understanding, skills, attitudes and values, enjoyment, inspiration and creativity as well as action, behaviour and progression. The complex nature of learning in exhibitions as described above discloses the need for a more detailed examination of the learning experience as interplay between visitors, exhibition objects and media, and other visitors. In order to do that, psychology provides a useful repertoire of concepts, methods and insights.

Forms Of Learning In Museum Exhibitions

From a psychological perspective, learning is defined generally as a *change process resulting from individual experience*. Hence learning is conceived as going beyond the intentional acquisition of knowledge in formal, highly structured settings, such as school education: it comprises gains in knowledge and competencies from formal or informal or even incidental forms of learning. It further comprises the development of new interests in specific subjects as well as changes in subject-related attitudes and beliefs. Such a wide definition also includes typical characteristics of informal learning in museum exhibitions (cf. Bransford et al., 2006): a high degree of voluntariness, free choice and self-regulation (Boekaerts & Minnaert, 1999) as well as a highly selective learning behaviour (Hsi & Fait, 2005).

Works on informal learning have often tried to distinguish between formal and informal learning according to settings that are characterized as being either formal or informal (e.g. school vs. museum). But a dichotomic view on formal vs. informal learning seems too simplistic and has been challenged lately by various approaches suggesting sets of attributes or dimensions rather than a categorical differentiation to distinguish “more formal” from “more informal learning” components in either “formal” or “informal” settings (Mayr, 2007). An example is given by the works of Malcolm et al. (2003) who identified four dimensions to differentiate between more formal and more informal learning in any setting: process, location/setting, purpose and content. Concerning *process*, learning that occurs during structured tasks given by a teacher and where the solutions are assessed later on would be considered formal, while learning that occurs during everyday activities that are executed without explicit teacher instruction together with others and without later assessment would be considered informal. Concerning *location*, learning in educational institutions leading to external certifications would be considered formal, whereas learning in the workplace, family or community that goes without certificates would be considered informal. Concerning *purpose*, more formal learning is defined by learning being a conscious focus of an activity and more informal learning the lack of this focus. Concerning *content*, finally, learning that occurs in order to acquire expert knowledge, propositional knowledge or specified outcomes (more formal), can be distinguished from the development of something new, everyday practice and incidental outcomes (more informal).

In consideration of such dimensions, learning in museums exhibitions to our opinion cannot be generally defined as being informal. Rather than that, we would ask for more formal or informal *components* of learning in exhibitions depending on the design of the specific exhibition, on the one hand, and the design of the concrete visit on the other: An *exhibition* may be either designed as highly structured and include predefined structured tasks (e.g. games, computer programs with defined goals) and focus explicitly on knowledge acquisition etc. – or it may be designed in a way that lets exhibits speak for themselves, focusing on aesthetic appreciation and contemplation without any explicit learning tasks. The same is true for smaller exhibition units within exhibitions which may differ in

their emphasis on didactical structure and on knowledge acquisition. Likewise, the *visit* of an exhibition may be planned by the visitors either as an explicit learning event, embedded in a context of formal education (such as school class visits) or include structured guidance (such as guided tours) – or it may be an incidental visit during a stay in a city, where a certain museum happens to reside. Also visitor behavior is not constant during a visit but varies in different phases of the museum experience and according to different exhibition unit designs. This shows that we cannot investigate “informal learning” in a museum exhibition as a whole, because it depends on what *really* happens during the visit of a certain museum exhibition whether we can define it as being a more formal or a more informal ways of learning. Also, studies of visitor behavior as well as analyses of knowledge acquisition in more formal contexts indicate that learning experiences in museums are not continuous and incremental, but should better be described as a sequence of discrete learning episodes (Billinghurst, 2005). It can further be assumed that each of these learning episodes relates to a single exhibition unit: a particular ensemble of related objects and media organized around a common theme. A typical example of such an exhibition unit is a single display cabinet with a collection of objects, accompanying labels, text posters, photos, and diagrams. Therefore, each exhibition unit should be considered as a potential occasion for a learning episode.

In consequence, what seems to us more suitable an approach to investigating learning in museum exhibitions is to focus directly on concrete exhibition units and visitor's learning episodes while drawing on psychological models of learning and concepts related to informal learning that can readily be applied to specific museum scenarios. According to current psychological models, learning episodes cannot be simply reduced to additively “filing” certain information in the head of the learner (Bransford, Brown, & Cocking, 2000). Instead, as constructivist learning theory has emphasized (Hein, 1998), learning should be better conceived as a process of active knowledge construction that implies a complex interplay of various mental processes which lead to an active construction of meaning. These mental processes include the motivation to learn and to acquire knowledge during the visit (Falk, Moussouri, & Coulson, 1998), interest in the given topic of the exhibition (Schraw & Lehman, 2001), the formulation of learning goals which the visitor tries to achieve (Mayr, 2007), the willingness to devote sufficient attentional resources to the various exhibits and media (Sweller, van Merriënboer, & Paas, 1998), and the mobilization of appropriate cognitive strategies for selecting, organizing, and elaborating relevant parts of the exhibition in order to gain a deepened understanding of the topics and to connect them to preexisting knowledge structures Mayer (2001). In other words, the traditional notion of learning as perceiving and storing information has been replaced by a conception which sees learning as an active, reconstructive, multi-step process which is best achieved when the learning is *situated* in an authentic and challenging context. The idea of “situatedness” is based on psychological models assuming that situated learning activities tying in with the learner's previous knowledge lead to higher interest, to richer mental representations and to a higher self-reference of the contents, resulting in a more flexible availability and retrieval of the knowledge acquired as well as an improved transfer into other areas of knowledge (Barsalou, 2004; CTGV, 1990; Greeno, 2006).

Using Digital Media To Design Exhibitions For Learning

The prerequisites for a successful learning experience outlined above define the criteria that exhibitions or exhibition units need to meet in order to provide opportunities for successful learning episodes. In analyzing existing exhibitions according to these criteria it was found that they provide a combination of exhibition units that each support specific elements of the learning process, overall forming a compensatory, balanced approach. For example, an unfamiliar object will preferably be embedded in a context which makes explicit connections to everyday experiences of the visitors in order to foster activation of prior knowledge. Likewise, familiar, seemingly uninteresting objects will tend to be presented in new, unfamiliar ways or will be accompanied by unexpected background facts in order to induce curiosity and interest. Therefore, depending on the topic, the objects, the media at hand, but also on the interplay of the designer's philosophy with the curator's interpretative intentions, each exhibition unit can be considered a unique solution to the design task of meeting the various requirements for successful learning episodes.

According to our analysis of a substantial number of current exhibitions in various countries, these solutions can be grouped into at least six different presentational prototypes. These prototypes, which will be described in turn, differ with respect to several dimensions, namely:

- how the given topic of the exhibition unit is thematically framed
- which elements of the learning process are emphasized by the design concept
- the amount of (both overt and mental) activities expected from the user
- which and how digital media are integrated into the exhibition unit.

Thus, the idea of presentational prototypes bears a strong conceptual relation to the notion of “framing”, as discussed in communication science and media psychology, and to the notion of “design patterns”, as discussed in architecture and software development. Based on these considerations, the following presentational prototypes can be distinguished:

- *Auratic presentation:* Here, single objects are presented as highly valuable, unique specimens, and the design deliberately refrains from accompanying information or media (typically in line with the notion that authentic objects “speak for themselves” and that supplementary media lead to a loss of “aura”). An example is provided by the isolated presentation of the Nebra sky disk (the oldest known representation of the night sky) in a display case with specific lighting focusing on the disk while the surrounding room is dark. The emphasis is on inducing curiosity and interest as well as processes of imagination and emotional valuation in the visitor. It is expected that visitors contribute a high amount of self-regulated cognitive activities. Digital media are lacking.
- *Classificational presentation:* Here, objects are presented as series of objects according to specific taxonomical or chronological schemes. An example is provided by mineral collections. The emphasis is on mental processes of comparison, induction, generalization and differentiation as means of cognitive elaboration. It is expected that visitors contribute a high amount of intrinsically motivated, self-regulated cognitive activities. Objects are often accompanied by graphical depictions of the underlying ordering scheme. The use of digital media is characterized by e.g. interactive regulation of the classificational grain-size.
- *Reconstructive presentation:* Here, reconstruction and illustration of (original) concrete construction and usage situations is focused. Examples are installations reconstructing the laboratory of an important researcher or dioramas showing dinosaurs in their “habitat”. Realistic, highly vivid and detailed presentational styles which preferably include multiple sensory channels are put in the foreground. Emphasis is put on mental processes of “transportedness” and involvement, leading both to heightened interest and development of analogous mental models. It is expected that users do not invest much mental effort in imagination and mental time travel as forms of information elaboration and should therefore be provided with vivid visualizations, on the other hand expectation of active, self-guided focussing of attention and exploration of the many details of the presentation. The use of digital media in form of 3D reconstructions, interactively explorable virtual realities and game-like simulations, as well as the use of advanced I/O-technologies like auto-stereoscopic displays or position tracking devices is often chosen.
- *Explanative presentation:* Here, complementary and detailed semantic information is presented by media together with the object. The explanation of underlying mechanisms, principles or theories is focused, like the physical laws on which the magnetic monorail technology is based. Emphasis is put on the generation of propositional knowledge and causal mental models, including processes of abstraction and generalization. It is expected that visitors are intrinsically motivated and interested, but do not invest much mental effort in mental reasoning as well as formulation and testing of hypotheses and that objects therefore should be accompanied by extensive and explicit explanations. The use of digital media takes the form of advanced – interactive, context-sensitive, adaptive, multimedia and mobile – database technologies including PDA's, mobile phones, RFID-tags; also interactive displays, animations and simulations for visualizing complex underlying phenomena are used.

- *Personalized presentation:* Here, objects and contents are tied in with individual prerequisites of visitors (e.g., previous knowledge, goals, interests, demand for information); personal references are established and personalization through empathy and identification with (fictional or real) people are elements of the exhibition. Making the visitors a part of the exhibition is central, e.g. by taking photographs of them that are digitally modified in order to show the effect of ageing. Emphasis is put on inducing interest and curiosity, activating prior knowledge structures, knowledge stabilization through self-relevance as well as heightened knowledge transfer to everyday situations. It is expected that visitors actively seek explanations and engage in processes of analogical reasoning and concept formation. The use of digital media as devices for adapted content provision, elaborate inquiry learning as well as for narrative story-telling is common.
- *Communication-oriented presentation:* Here, possibilities are provided for the exchange of opinions and discussions among visitors, as well as creative or playful offers for the collaborative or cooperative acquisition of exhibition content; referring to current social debates, e.g., about genetic modification is common. The focus is on social comparison and cognitive conflict as the motor of elaborative information processing. Digital media are used as extended (synchronous or asynchronous) communication platforms through which visitors can get in contact; also digital media link museums with other settings, such as school or home.

In sum, as can be seen from the list above, digital media are not only means to provide supplementary information but can support learning processes in exhibitions in a number of ways. Each of the mentioned elements of the learning process, from becoming interested and curious to mobilizing resources and activating appropriate strategies, can be facilitated (or hindered) by use of digital media in exhibitions. Immersive scenarios and new display techniques such as 3D screens allow an advanced visualization of complex phenomena while adaptively allowing to make specific features more salient. Opportunities for self-directed, even location-based information retrieval let museum visitors select content adapted to their individual preferences, information needs, interests and goals. Personalization and visitor integration strategies increase the self-relevance and enhance the motivation to look into specific subjects. Media asking for the visitor's input in terms of content knowledge and personal positions help to activate, retrieve and organize knowledge and support the formation of higher-order knowledge structures including well-founded opinions. Digital media facilitating interaction and communication between visitors pay tribute to the social nature of a museum visit and the supporting function of "knowledgeable others" for learning processes. Finally, elements such as emailing functions or individualized web links provide possibilities to extend the museum visit, and hopefully the engagement with the contents provided, to times and places beyond the specific on-site museum visit.

Research into Learning in Museums with New Technologies

The relevance of museums as places for learning, their unique object-oriented and spatial approach, a psychologically substantiated understanding of learning episodes that might occur around exhibition units in museums, as well as the potential contributions of digital technologies to learning provide the background for the research project "Learning in the museum: the role of media". The project examines learning processes on the part of visitors in science and technology exhibitions. Central to the research is the question how different forms of media-supported presentational prototypes contribute to the development of interests, the acquisition of (higher-order) knowledge and competencies. The project consists of 12 sub-projects in total, mainly doctoral dissertations, that analyze different presentational prototypes combined with a range of different technologies and innovative usage patterns. The research projects can be grouped according to the presentational types covered, namely:

- *Auratical and classificational presentation:* This group contains research projects that examine the learning opportunities provided by a display case showing a large number of photo and film cameras in a chronological and thematic array with no direct object labels,

located in the new “Foto + Film” exhibition at the Deutsches Museum Munich. Studies examine this basic form of presentation (Gun-Brit Thoma, IPN) as well as variations with additional information provision either via text and picture elements applied to the showcase or via a transparent touch screen providing access to a large database of information about individual objects (Alexandra Donecker, Deutsches Museum).

- *Reconstructive presentation:* This category is covered by a project that examines the role of reconstructions of no more existing objects or circumstances for the experience and recall of archaeological television documentaries, concentrating on re-enactments and virtual reality (VR) representations. In her dissertation, Manuela Glaser (KMRC) examines how these reconstructions influence the feeling of “transportedness” into the depicted era, the subjective familiarity with the content and how these variables affect the credibility and the dating of the presented contents.
- *Explanative presentation:* Among the three research projects dealing with the explanatory use of digital media one uses mobile devices to provide additional information about exhibition content as well as access to external sources such as Wikipedia in order to allow a self-directed selection of information according to individual interests and previous knowledge (Daniel Wessel, KMRC). Markus Huff (KMRC) and Nadine Herrmann (Deutsches Museum) examine the learning potentials of an auto-stereoscopic display designed to provide an integrated visualization of two different representations of molecule models as part of a planned exhibition about nanotechnology at the Center for New Technologies of the Deutsches Museum.
- *Personalized presentation:* Two main forms of personalization are covered by research projects in this group. Joern Toepper (KMRC) and Martina Haenle (Deutsches Museum) make use of personalized films with personal stories of people affected by spare parts such as artificial limbs on the one hand and films of people stating their personal experiences and opinions about genetic tests on the other. The activation of shared personal goals for the visit is the strategy used by Eva Mayr (Virtual PhD Program/KMRC). It is assumed that awareness of shared goals and presentation of adaptive information that re-situates exhibits in the context of visitors’ shared interest, enhance learning on the part of visitors coming in a small group.
- *Communication-oriented presentation:* This last group of projects covers a media station providing possibilities for the exchange of opinions and discussions among visitors (Kristin Knipfer, Virtual PhD Program/KMRC), collaborative media design tasks for promoting explorative behavior and cognitive elaboration for school class visits in the museum (Lars Kobbe, KMRC) and finally, motive-oriented ways of information structuring where visitors rate the information content and the difficulty of exhibits. These ratings are visually fed back in the exhibition, and it could be shown that visitors who differ with regard to their goal-orientation take different ways through the exhibition when they are aware about this kind of social information (Daniel Bodemer, University of Tuebingen/KMRC).

Conclusion

The research project “Learning in the museum: the role of media” explores the learning potentials of digital media in museum exhibitions. The research approach takes into account the relevance of museums as places of learning while drawing on a psychologically substantiated understanding of learning processes in museums, but also considers the unique object-oriented and spatial approach and the variety of presentational prototypes present in museum exhibitions, and finally the potential contributions of digital technologies. In pursuing the research questions the project aims to examine questions relevant for museum practice while at the same time contributing to the body of knowledge in the field of informal learning as well as further developing useful methodologies to examine informal learning processes in museums. Based on the findings, we hope to derive recommendations about how exhibitions and especially digital media elements can be evaluated, advanced and optimized with regard to their learning potentials.

Bibliographie :

- Allard M., Lefebvre B. (sous la dir. de), *Musée, culture et éducation = =Museum, culture and education*, Ed. Multimondes, 2001.
- Allard M., Lefebvre B. (sous la dir. de), *Le musée, un projet éducatif*, [actes du 2^{ème} colloque annuel du GISEM (Groupe d'intérêt sur l'éducation et les musées) organisé en juin 1994 à l'Université de Calgary], Ed. Logiques, 1996.
- *Courants contemporains de recherche en éducation muséale = = Contemporary research trends in museum education* / dir. Tamara Lemerise, Dany Lussier-Desrochers, Vitor Matias, Ed. Multimondes, 2002.
- Csikszentmihalyi M. & Hermanson K., "Intrinsic motivation in museums: Why does one want to learn?" In J. L. Falk & L. D. Dierking (Eds.), *Public institutions for personal learning: Establishing a research agenda*. Washington, D.C: American Association of Museums, p.67-77, 1995.
- Maestracci V., "Quelle jungle!", *Les Révolutions industrielles de la musique*, p.169, Cahiers de médiologie, IRCAM/Fayard, coordonné par O. Donnat et B. Stiegler, n°18, novembre 2004.
- *Le regard instruit : action éducative et action culturelle dans les musées* / Actes du colloque organisé par le service culturel du Musée du Louvre, le 16 avril 1999 ; Auteurs : Directeur de publication : Jean Galard, La Documentation française (Editeur), 2000.
- Vidal G., *Contribution à l'étude de l'interactivité : les usages du multimédia de musée*, Presse universitaire de Bordeaux, 2006.

Webographie :

- <http://www.deutsches-museum.de> : site du Deutsches Museum qui est l'un des plus grands musées des sciences et de la technique au monde, situé à Munich.
- <http://www.educnet.education.fr/arts/ress-numerique/sites-art> : site du Ministère de l'Éducation Nationale où sont référencés les sites Internet éducatifs des institutions culturelles.
- www.histoire-image.org: site élaboré par la RMN en partenariat avec la Direction des musées de France et la Direction des Archives de France sur l'Histoire de France à travers les collections des musées et les documents d'archives.
- <http://www.iwm-kmrc.de/museum/en/> : site du Knowledge Media Research Center (Tübingen, Allemagne).
- www.louvre.edu : site éducatif du musée du Louvre qui permet d'accéder à des ressources visuelles, textuelles et sonores autour des collections du musée.
- <http://www.slideshare.net/Frankwatching/conferentie2008-presentation> : *Outside in the Agora – Mobile Interpretation and Socratic Dialogue in the 21st Century Museum*, Nancy Proctor, 9 décembre 2008.
- <http://www.si.edu> : site de l'Institution Smithsonian (Etat-Unis).