

# Multi-touch interfaces in museum spaces: reporting preliminary findings on the nature of interaction

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## Abstract

For the past twenty years there has been a slow trickle of research disseminated through a variety of channels on the nature and use of computer interactives within museum and gallery environments. This research has yet to be consolidated into a robust and coherent evidence base for considering and understanding the continued investment in such interactives by institutions.

Simultaneously however, the technology has changed almost beyond recognition from early kiosk-based computer exhibits featuring mostly film and audio content, through to the newer generation of multi-touch interfaces being introduced in the UK and beyond. This paper seeks to establish what can be gleaned from prior research in the field of computer interactives, to inform the study of these latest technological forms. It reports preliminary observations from the study of multi-touch interfaces and discusses issues identified for their continued investigation; principally, asking questions about the nature of experience and interactivity in such encounters and the research methods that we might use to better explore and understand their use in the future.

## 1 Introduction

‘We are crossing the threshold into the Era of the Good Interface’ (Dodsworth, 1999)

For the past twenty years there has been a slow trickle of research disseminated through a variety of channels on the nature and use of computer interactives within museum and gallery environments. This research has yet to be consolidated into a robust and coherent evidence base for considering and understanding the continued investment in such technologies. This is no doubt for a variety of reasons; the case by case (institution by institution) evaluative nature of much of the research; the interdisciplinary scope of much of the investigation meaning that publication takes place in a host of varying locations<sup>1</sup>; the variety of approaches to study which can make consolidation or comparison of findings problematic; and the number of technologies that are seen to constitute the field (if we can call it that) of computer interactives.

Simultaneously however, we have seen the technologies on offer to museums change almost beyond recognition from early kiosk-based computer exhibits (Gammon and Burch, 2008) featuring mostly film and audio content, through to the newer generation of multi-touch

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<sup>1</sup> Online databases of conference proceedings like <http://www.archimuse.com/index.html>, Museum and Heritage Journals, Education Journals, Technology, Information Science and even Engineering outlets.

interfaces currently being introduced through new exhibitions in the UK and beyond. Such a change means that the variety of encounters with digital information currently on offer at any one site may be very varied in terms of usability, access and (no doubt) use-value; namely, experience. This shift has been accompanied by a rising interest in what mobile media may also add into the mix, with increased research activity around the use of PDAs, mobile phones, QR codes and RFID tags.<sup>2</sup> In the last decade, more advanced forms of mixed interactive systems have been developed which include augmented reality (AR), mixed reality (MR) and tangible user interfaces (TUI) or ‘tangible interactives’.<sup>3</sup> These latter terms recognise tangibility and materiality in new ways; embracing the physical embodiment of data, bodily interaction and embeddedness in real spaces and contexts (Eva Hornecker, 2009). Additionally, according to Hornecker the idea of tangible interaction focuses on human control, creativity and social action rather than the representation and transmission of data, a shift which would have significant implications for the role and status of interactives in museum spaces.

Such far reaching developments make for a rather incoherent knowledge base, and raise serious methodological concerns. This paper will be unable to elucidate on the breadth, scope and impact of these changes in context, but instead seeks to explore the study of multi-touch interfaces in particular. The distinction is made between various ‘computer interactives’ and ‘multi-touch interfaces’ in a variety of ways. Computer interactives (Figure 1) tend to be static, the size of your average computer monitor, and navigated by a sole individual (indeed a sole finger) providing information on a number of different levels. They tend to be characterised by their kiosk appearance and (necessarily) dark surroundings. Multi-touch interfaces (Figure 2) may house similar kinds of information, but are differentiated by the mode and aesthetics of their presentation. The interface tends to be a flat, horizontal tablet screen that can be accessed (and read) by a variety of people at any given time. These interfaces tend to be more happily integrated into exhibitions as the restrictions on their presentation are fewer.

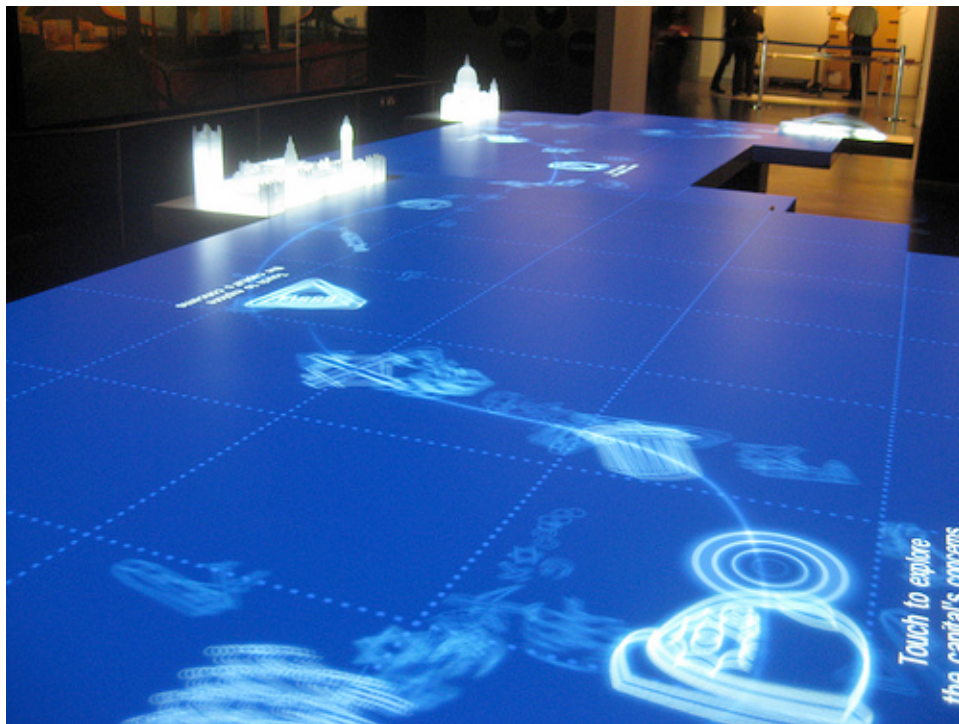
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<sup>2</sup> The technologies are under-researched and there is no consistent body of knowledge but see Hsi 2003; 2004; Fleck et al. 2002, Baldwin and Kuriakose, Lejoe Thomas, 2009; and Lehn and Heath, 2005 on RFID and PDAs (also vom Lehn and Heath, 2003 and Woodruff et al, 2001 on PDAs); Tallon and Walker (ed), 2008 on mobile phones; and more recently Chan, 2009 and Flowers, 2010 on QR codes and apps.

<sup>3</sup> Ullmer and Ishii, from the Tangible Media Group at the MIT Media Lab, define TUIs as devices that give physical form to digital information, employing physical artefacts as representations and controls of the computational data (Ullmer and Ishii, 2000).



*Figure 1: Computer interactive at the Victoria and Albert Museum*



*Figure 2: A multi-touch interface at the Museum of London. Multiple point of entry can be identified.*

The dubious nature of the ‘interactivity’ on offer through screen-based media at museum sites is notable, but the shift to ‘interface’ demonstrated in this paper is more than mere semantics. It implies that there are important changes to both the hardware and software being utilised, and the inputs and outputs being detected, but falls short of indicating a genuine two-way communication. There are issues of power and authority at play in any museum/visitor transaction, and the easy promise of participation, collaboration and interactivity has been all too seductive in recent years.

This paper gives an overview of preliminary findings related to the use of multi-touch interfaces in museum environments along two thematics: the nature of experience and interactivity in such encounters (including levels of sociability and comfort); and the research methods that we might use to better explore and understand their use in the future. It concludes with a number of pointers for further research, and a brief commentary on the positionality of computer interactives more generally within the larger narratives constructed by institutions. In exploring preliminary findings, the paper also seeks to establish what can be salvaged from prior research to inform investigation of multi-touch interfaces in particular.

This paper thus begins to explore whether we might at last be entering the ‘Era of the Good Interface’, or if the situation might be better described as ‘business as usual’ in respect to multi-touch interfaces. Are such opportunities for experience and interaction no more than an extension of those activities offered through previous incarnations of the ‘computer interactive’? Or is there scope to explore and recommend them as more social, educative, coherent and fluid contributions to the museum narrative? The approach here is cross-disciplinary, empirical and critical at core, but might be best described as ‘socio-technical’ in perspective (Sawyer, 2005: 9).

## **2 Preliminary observations**

This section reports preliminary observations of users’ encounters with computer interactives carried out in 2010 at 9 museums in England. The researcher observed more than 100 screen-based interactions in total, including 30 encounters with multi-touch interactives. The purpose of the observation was to try and establish any shift in terms of the (visible) nature of experience and interaction, and to think creatively about how we might try and capture something of that experience through non-intrusive research methods in the future. A number of promising lines of enquiry were noted, and are detailed here under the headings; experience and interaction, and methodological implications.

### **2.1 Experience and Interaction**

The experience of using the multi-touch interface is visibly a significantly more social one than the use of traditional computer interactives observed. One of the major criticisms of computer interactives in the past has been that they can limit users’ social experience of museum environments (a crucial aspect of any museums visit according to Falk and Dierking and a key component of any learning outcome, 2008). It has been noted that the computer screen is not best suited to enabling social interaction (Gammon and Burch, 2008:47), and to expect multiple visitors to feel comfortable using a computer at one time is of course counter to our use of and engagement with computer screens in most of our day to day activity.

In the study, people were observed to engage with interfaces simultaneously and in groups from all available sides, and often to carry out multiple ‘tasks’ on the interface at one time. The nature of these encounters of course remains allusive, and establishing a means for

gathering information about them continues to present methodological challenges (as will be seen). Such use of the interface does however represent a step towards ‘overhearing’, ‘co-participation’ and ‘multi-party participation’, activities that vom Lehn and Heath are eager to encourage more readily around computer interactives (2005: 15). Indeed, to noted museum consultant Nina Simon, it is only when individuals and groups communicate with one another around content (not through it) that productive participation and interaction are being facilitated (Simon, 2010). It would be interesting to see also how the new generation of multi-touch interfaces and TUIs which incorporate physical artefacts in interactive experiences might (as is their aim) aid users’ collaborative activities with one another. It is crucial to the future research agenda that we understand more about the nature of such social encounters, for example, asking questions about whether they are characterised by frustration, enquiry, knowledge exchange, or are completely ‘off topic’.

Observation of social encounters thus raised questions about how we might more usefully conceptualise the ‘social museum’ and understand the relationships between collective and individual engagement; the body and experience; the group and knowledge construction. Understanding where, how and whether computers interfere with, support or enhance such relationships will be of critical importance going forwards.

It was noted in the use of digital devices of all types that there were different kinds of permissions at play than at other exhibits on the museum floor. For example, whilst children in groups often ran up to interface exhibits and started engaging, they were less likely to do so until they had been given ‘permission’ when it was a traditional computer interactive. This is perhaps due to the nature of young people’s relationships with monitor based computers at home or school, but does indicate that the multi-touch interface perhaps suffers less from that kind of association.

It has been recognised in prior literature that computer interactives tend to appeal particularly to children (Ramsay, 1998; Gammon, 1999) who may not be the target audience for the information, but who will commit (at some level) to using the device none-the-less. ‘Interactivity’ has been central to attempts to engage children and young people within museum spaces for many years, not least because of the roots of that principle in philosophies of experiential learning (Dewey 1997) and constructivism (Piaget 1957). McLean (1993) defines interactive exhibits as ‘those in which visitors can conduct activities, gather evidence, select options, form conclusions, test skills, provide input and alter a situation based on input’. Such things are seen as critical to learning ‘outcomes’. In one study, Hein and Heald (1988) found that multi sensory interactive installations kept visitors for more time at exhibits and subsequently increased visitor knowledge. Nonetheless, interactions with multi-touch interfaces and computer interactives depend largely on their application and their setting.

For both children and adults who use computer interactives, there is a recognised problem of pacing which needs further attention in research. Being able to move at one’s own pace through the exhibit is important, yet computer interactives (and especially those that have been in situ for a number of years) can be slow to respond, with delays causing frustration

and faltering confidence on the part of the user; they may be quick to assume they have ‘done something wrong’. Some touch-screen interfaces tend to suffer similarly in terms of responsiveness, even though the aesthetics of their presentation might indicate that they are more novel and user-centric.

Designers of multi-touch interfaces must consider the fact that any appeal associated with the ‘newness’ or innovation of certain technologies can work as either a help or hindrance when it comes to prompting participation. For some visitors innovative technologies might be unfamiliar and daunting, for others, those same devices might seem already outmoded. One notable finding from observing an additional group of University students using touch-screen interfaces was that they often expected them to respond in the manner of smartphones or personal tablet devices to which they are now increasingly accustomed, and often found them to be lacking in responsiveness and usability. In conversations during the visit they made ready comparisons to the high resolution retina display and responsive functionality of these other platforms that they are increasingly using on a daily basis. We see how quickly museum visitors (or more likely a portion of museum visitors) use of media outstrips the pace at which the institution can reasonably be expected to update. This problem is unlikely to diminish in coming years unless more is done to embrace the technologies that visitors increasingly come to museums with in their pockets (smartphones, apps and QR codes are increasingly being experimented with, for example at the Museum of London).

In terms of positionality, there tended to be far greater flow around multi-touch interfaces than computer interactives. This was due to their design, but also to their positioning within exhibition spaces. They tended to be more integrated into the narrative of the exhibition, and simultaneously were often presented as star attractions due to their novelty and size. Thus, a significantly higher proportion of people who entered the gallery spaces tended to use them than used computer interactives. As Gammon and Burch have said, a device ‘needs to dovetail with the activity of museum visiting’ beyond that, for ultimate use-value, it should be ‘available as soon as it is required and [be] unobtrusive when it is not needed’ (Gammon and Burch, 2008:42). Ensuring a suitable balance between the site and any devices therein should also help to alleviate any concerns that a shift towards creative digital content might facilitate a ‘death of the object’ (Parry, 2007). Delicate balancing and considered exhibition design can create narrative flow.

Commitment to multi-touch interfaces did seem to be slightly more varied than that to computer interactives, again this is something that needs more exploration. This is perhaps an inevitable outcome of the increase in social interaction associated with them (and less often immersive personal long-term engagement). Multi-touch and tangible interfaces are designed to be inherently playful, imaginative and immediate. In fact, researchers in Human Computer Interaction Design (HCID) have recently added the goals of enjoyment, emotional engagement, ambiguity and ludic design (Wakkary, Hatala 2006) to their analysis of principles for interaction (alongside usefulness and usability). An understanding of both ergonomic aspects and cognitive psychology developments is perhaps then a desirable basis for designing computer interactives, and unpacking their use in museum spaces.

An understanding of the frames of interaction – how they are constituted and understood by visitors - also remains crucial because, as Dodsworth notes; ‘Only the very best interfaces can teach you how to use themselves. That is where our youngest devices, computers, fail most miserably – because they are also our most powerful and enable us to make mistakes most efficiently’ (1999). The narrative of the interactive itself is a big part of this. How does the story/game/information unfold? Research shows that users tend to spend longer at interactives when they understand their role within a narrative, and when that narrative has a clear point of completion (Ramsay, 1998). Likewise, some navigational metaphors can serve to frustrate and confuse users (ibid). Simple yet intuitive operations are the gold standard of computer interactivity.

This is something that should be a key focus in follow-up research, especially for museums interested in learning. Some authors have maintained that many current models of operation used in museums do not adequately acknowledge that learning may depend on previous knowledge and different sociocultural relations to the museums activities (e.g. Hein, 1998; Hooper-Greenhill, 1994). Nonetheless, emphasis has been given to multiple learning modalities in recent years, creating opportunities at least to access information through different mechanisms and modes of address. The multi-touch interactive is one such mechanism, but to evaluate how people make sense of the information they find through such means, involves further understanding the types of activity they facilitate; are people browsing, searching, exploring or playing (i.e. is their use purposeful, exploratory or playful, Gammon, 1999). This brings us to a discussion of the methodological implications of their study.

### 2.3 Methodological implications

Of course, all kinds of questions emerge from such encounters which we cannot hope to answer through observation alone: Was the nature of the encounter meaningful to the individual or group? Would the institution consider it to be meaningful? Was meaning making being demonstrated? Is it clear what use-value the group anticipated in using the interface? Were the group expressing frustration about aspects of the user experience?<sup>4</sup> Such questions require us to look beyond the quantitative and measurable aspects of experience, for example the route of enquiry through the interface’s various offerings, or the length of time spent at the interface, toward the qualitative nature of the groups’ exchanges, such as what was actually said, or how the group manoeuvred around and through the space.

Some analysis and research has been carried out into such interfaces (Hornecker, 2008) but mainly as lab based user studies aiming to investigate interaction techniques<sup>5</sup>, and there have

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<sup>4</sup>Or perhaps, as was noted, these kinds of interfaces become natural gathering sites for parties to re-group before continuing their journey through the museum.

<sup>5</sup> Such as the SHAPE project ([www.shape-dc.org/](http://www.shape-dc.org/)) and the MUMMI project which are looking into the development and understanding of mixed reality interfaces, including design issues and accessibility matters.

been even fewer studies devoted to multi-touch interfaces as they are defined in this paper (see the ShareIT project as an example<sup>6</sup>). Such studies often use summative evaluation techniques (quantitative and qualitative); mostly in the use of observations and interviews. However, the researchers' findings are focused primarily on design aspects, perhaps a result of the principally evaluative nature of much of this study (and not a commitment to a wider research agenda). Many such studies collect and analyse data about usability, that is, user *performance*, yet disregard the knottier issue of user experience, that is, user *satisfaction*, which is a more resource intensive mode of study dealing in human emotion (Bevan, 2009).

The findings from prior studies are vital as they begin to provide an understanding of and appreciation for participatory design and usability (the Design for All principle<sup>7</sup>), but do less well in helping us understand issues of user experience. It is thus vital to constitute a research approach that understands and positions visitors as protagonists within complex museum narratives which can be understood in more holistic terms. Thus, we would like to propose the pursuit of an inter-disciplinary method where computer sciences and humanities approaches including museum practices collaborate on field studies. Such an approach might reveal narratives about the visitors' use of and engagement with interfaces as well as an analysis of design usability and functionality (through qualitative approaches such as interviews) coupled with an additional quantitative narrative of the museum visit (provided by sensing technologies such as RFID and other measures).

It is important that visitors, beyond making sense of an interactive as a stand-alone interpretive tool, are able to understand that encounter within the overall framework of the museum and their museum visit. Current research and evaluation stops short of providing a means of understanding or articulating how visitors value their interactions with multi-touch interfaces within the larger narratives constructed by institutions, or within the various social encounters they have around them. Observations have revealed that multi-touch interfaces may be challenging some of the findings about computer interactives that have emerged in the past 20 years but have raised numerous other questions about the nature of experience and interaction also.

Understanding the contribution of multi-touch interfaces to the museum experience will be crucial in justifying the expenditure that is increasingly being earmarked for them, especially in the face of so many competing technologies and devices. As Falk and Dierking remind us below, it is the relationship between 'experience' and 'value' (in learning, but also inevitably financial, terms) that museums have the most invested in:

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Other studies include work on the 'Tree of Life' interface<sup>5</sup> in the Berlin museum (Hornecker 2008), work on the exhibition 'The Fire and the Mountain' in the Civic Museum of Como (Italy) and an evaluation report on visitors responses on the interactives in V&A museum (McIntyre, 2003).

<sup>6</sup> The interdisciplinary ShareIT project investigates the benefits of new shareable technologies by the Open University's Department of Computing which collaborate with the Psychology Department at the University of Sussex from October 2008.

<sup>7</sup> Design for All (DfA) is design for human diversity, social inclusion and equality (EIDD Stockholm Declaration, 2004).



It is not enough that new technologies enhance the visitor experience; it needs to be demonstrated that these new technologies enhance the visitor experience better than competing technologies and in ways that are cost-effective. It is not until the field has a strong research base that it will truly be able to both optimize the power of these digital media tools and substantiate their value. (Falk and Dierking, 2008: 28)

## References

Abell K. S., Lederman G.N. (2007). *Handbook of research on science education*. Lawrence Erlbaum Associates Inc., New Jersey, USA

Allen S., Gutwill J. (2010). *Designing With Multiple Interactives: Five Common Pitfalls*. Curator: The Museum Journal, Volume 47, Issue 2

Baldwin, Timothy and Kuriakose, Lejoe Thomas, 2009, 'Cheap Accurate RFID Tracking of Museum Visitors for Personalized Content Delivery' at [http://conference.archimuse.com/biblio/cheap\\_accurate\\_rfid\\_tracking\\_museum\\_visitors\\_personal](http://conference.archimuse.com/biblio/cheap_accurate_rfid_tracking_museum_visitors_personal)

Bevan N. (2009). *What is the difference between the purpose of usability and user experience evaluation method?*. Professional Usability Services, London, UK.

Chan, Seb, (2009), various posts including <http://www.powerhousemuseum.com/dmsblog/index.php/2009/03/05/qr-codes-in-the-museum-problems-and-opportunities-with-extended-object-labels/> on work at the Powerhouse Museum

Dodsworth, Clark, 1999, 'The Evolution of Tools...and the Devolution of the Users' in *The Informal Learning Review* available at [www.informallearning.com/archive/1999-0506-b.htm](http://www.informallearning.com/archive/1999-0506-b.htm)

Falk, John H., and Dierking, Lynn D., 2008, 'Enhancing Visitor Interaction and Learning with Mobile Technologies' in Tallon, Loic and Walker, Kevin (eds), 2008, *Digital Technologies and the Museum Experience: Handheld guides and other media*. Lanham, New York, Toronto, Plymouth: Alta Mira Press: Lanham, New York, Toronto, Plymouth.

Fleck, Margaret, Frid, Marcos, Kindberg, Tim, Rajani, Rakhi, O'Brien-Strain, EAmonn and Spasojevic, Mirjana, 2002, 'From Informing to Remembering: Deploying a Ubiquitous System in an Interactive Science Museum' available at <http://www.hpl.hp.com/techreports/2002/HPL-2002-54.pdf>

Flowers, Alex, 2010, 'Integrating QR codes into galleries' at <http://alexflowers.co.uk/2010/10/28/integrating-qr-codes-into-galleries/>

Gammon, Ben and Burch, Alexandra, 2008, 'Designing Mobile Digital Experiences' in Tallon, Loic and Walker, Kevin (eds), 2008, *Digital Technologies and the Museum Experience: Handheld guides and other media*. Lanham, New York, Toronto, Plymouth: Alta Mira Press: Lanham, New York, Toronto, Plymouth.

Gammon, Ben, 1999a, 'Visitors' Use of Computer Exhibits: Findings from 5 Grueling Years of Watching Visitors Getting it Wrong' in *The Informal Learning Review* available at [www.informallearning.com/archive/1999-0910-a.htm](http://www.informallearning.com/archive/1999-0910-a.htm)

Gammon, Ben, 2008, 'Everything we Currently Know About Making Visitor-Friendly Mechanical Exhibits' in *The Informal Learning Review* available at [www.informallearning.com/archive/1999-1112-a.htm](http://www.informallearning.com/archive/1999-1112-a.htm)

Hatala, M., Wakkary, R., *Ontologies-based user modeling in an augmented reality system for museums (2005)*, *User-Modeling and User Adaptation Interaction*, The Journal of Personalization Research, Vol 15, Issue 3-4, pp. 339-380

Hornecker E.(2008). *Tangible Interaction - An Inclusive Perspective*. form+zweck 22 (vol 40). English pages 78-85 ([www.formundzweck.de](http://www.formundzweck.de))

Hornecker E. (2008), *"I don't understand it either, but it is cool" Visitor Interactions with a Multi-Touch Table in a Museum*. Proc. of IEEE Tabletop 2008. 121-128

Hsi, S. (2003), 'A study of user experiences mediated by nomadic web content in a museum' in *Journal of Computer Assisted Learning*, 19, 308-319

McIntyre H.M (2003). *'Engaging or Distracting? Visitor responses to interactives in the V&A British Galleries'*, V&A British Galleries Summative Evaluation, UK

Naumann B.A., Schleicher R., Wenschung I. *Views on Usability and User Experience: from Theory and Practice*. Deutsche Telekom Laboratories, TU Berlin. <http://www.cs.uta.fi/~ux-emotion/submissions/Wechsung-et-al.pdf>

Parry, Ross (2007), *Re-Coding the Museum: Digital Heritage and the Technologies of Change*. Routledge.

Ramsay, Grahame, 1998, 'Investigating 'interactives' at the Powerhouse Museum: Personal, social and Physical context' available at <http://www.ascilite.org.au/aset-archives/confs/edtech98/pubs/articles/ramsay.html>

Rizzo F., Garzotto F. (2007), *"The Fire and the Mountain": Tangible and Social Interaction in a Museum Exhibition for Children*, Department of Electronics and Information, Politecnico of Milano. Presented in IDC 2007 Proceedings: Tangible Interaction, Aalborg, Denmark.

Sawyer, S. (2005), 'Social Informatics: Overview, Principles and Opportunities' in *Bulletin of the American Society for Information Science and Technology*. June/July 2005 pp. 9-12.

Simon, N. (2010), *The Participatory Museum*. Santa Cruz: Museum 2.0.

Tallon, Loic and Walker, Kevin (eds) (2008), *Digital Technologies and the Museum Experience: Handheld guides and other media*. Lanham, New York, Toronto, Plymouth: Alta Mira Press: Lanham, New York, Toronto, Plymouth.

vom Lehn, Dirk and Heath, Christian (2005), 'Accounting for New Technology in Museum Exhibitions' in *International Journal of Arts Management*, VOL.7(3): pp.11-21

vom Lehn, Dirk and Heath, Christian (2003), '*Displacing the Object: Mobile Technologies and Interpretive Resources*' paper from ICHIM 2003, Paris. Archives and Museum Informatics Europe.

Woodruff, Allison, Aoki, Paul M., Hurst, Amy and Szymanski, Margaret H. (2001), '*Electronic Guidebooks and Visitor Attention*' paper from ICHIM 2001 available at [http://conference.archimuse.com/biblio/electronic\\_guidebooks\\_and\\_visitor\\_attention](http://conference.archimuse.com/biblio/electronic_guidebooks_and_visitor_attention)