Learning with Digital Technologies in Museums, Science Centres and Galleries

Roy Hawkey

FUTURELAB SERIES

REPORT 9:

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FOREWORD

In the last few years there has been massive growth in the use of digital technologies for learning in museums, science centres and galleries – both on-site in the form of digital interactives, and online via the creation of ever-more popular websites. As early as 2002 the number of virtual visitors to many museums' websites had already overtaken the number of physical visitors on-site. These developments, both within the walls of the institution and outside them, provide a number of challenges for educators and curators, at the heart of which lie the questions – what is distinctive about learning in museums, science centres and galleries, and how might this change or evolve through the increasing use of digital technologies?

These questions go to the heart of significant debates in this sector – how does learning in musems differ from or complement learning in schools? How can museums fulfil their potential to support lifelong learning? Should effort and money be spent primarily on the visitors who will enter the walls of the institution or those who will virtually explore the site through the web? What is the role of objects in the process of learning with digital technologies? How does the relationship between museum educator and learner change as technologies are developed?

At a time when there are calls for collaboration between schools and the informal learning sector, when there is increasing emphasis on lifelong learning, when there is significant debate over the value and utility of digital resources, this review takes a step back and asks us to consider the bigger picture – the history and role of learning in museums, science centres and galleries, the theories that can help us to navigate the as yet unclear waters of the future, and the major projects and initiatives that are already providing indications of the routes we might take.

We look forward to hearing your views on this review and welcome comments at research@futurelab.org.uk

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EXECUTIVE SUMMARY

museums, galleries and science centres are among the most enthusiastic providers of digital learning opportunities

EXECUTIVE SUMMARY

1 INTRODUCTION AND BACKGROUND

As institutions for the general public, museums pre-date schools yet the popular assumption is that schools are for learning (and for preparation for the future) while museums are for the preservation of the past. The reality may well be, however, that it is museums that have embraced new technologies and approaches to learning while schools focus on delivering an outmoded curriculum.

Museums are a heterogeneous set of institutions whose original twin functions of scholarship and education, once inseparable, but subsequently divorced, are being reunited by digital technologies. Such technologies also encompass a wide variety, including multimedia, simulations and presentations as well as the internet. Not only do they facilitate and/or accelerate long-established learning tasks, but, critically, they permit activities that would otherwise be impossible. This includes new approaches to learning by different audiences and for different purposes.

Despite reservations about access – with social class the major determinant – digital technologies for learning are available to the majority of UK households and to almost all UK schoolchildren. Museums, galleries and (especially) science centres are among the most enthusiastic providers of digital learning opportunities. Virtual visitors to museum websites already out-number physical (on-site) visitors, and many of these are engaged in dedicated learning activities – as even a cursory glance at the 24 Hour Museum website will confirm. Indeed, so rapid and widespread has been the growth – in both provision and uptake – that the extensive survey of UK museum education activity in 1999 did not include websites and conflated audio-visual guides with printed materials.

2 LEARNING IN MUSEUMS

Museums have a number of philosophical and practical considerations when planning learning opportunities, namely to:

- engage in learning as constructive dialogue rather than as a passive process of transmission
- take on the role of privileged participant rather than that of expert
- carefully evaluate the significance of the formal school curriculum (and its assessment process)
- facilitate lifelong learning by providing a free-choice learning environment that permits a plethora of pathways and possibilities.

Museums have an important role to play in facilitating lifelong learning, in terms of creative, cultural and intellectual activity beyond any merely vocational aspects. Lifelong learning, museums and digital technologies share many of the same attributes, with emphasis on learning from objects (rather than about objects) and on strategies for discovering information (rather than the information itself). Such a view of learning as active engagement is supported by The Campaign for Learning in Museums and Galleries (CLMG) and the Museums, Libraries and Archives Council (MLA), who also celebrate the important (if different) outcomes of informal learning.

Many of the informal learning opportunities offered by museums, through digital technologies and in other ways, sit uncomfortably with the formal education system. Indeed, far from reducing tensions between the formal and informal learning sectors, the drive for 'learning objects' may create further stresses.

3 ON-SITE LEARNING

Objects are the unique attribute of museums and galleries, their USP, yet many museums and science centres apparently seek the Holy Grail of interactivity. Most of the learning issues are similar, whether interactives are mechanical or digital, on-site or online. In any case, poor examples, of whatever type, do little to promote the learning potential of interactives. While some authors question the compatibility of objects and interactives, there are key principles emerging. Beyond the naïve assumption that digital technologies are inevitably interactive, there are strident demands for clear learning objectives, for learner choice and initiative.

After interactivity, the goal of many museums is learner participation. This may involve simple feedback (often digital voting), digital storage of images and ideas (for subsequent remote retrieval) or even contributing directly to the museum's own exhibits and interpretation.

Digital technologies facilitate many kinds of collaboration – between museum and learner, between different institutions and among learners themselves. Exciting examples include those between real and virtual learners and of learners creating their own associations within and between collections.

In many ways the opposite of collaboration, digital technologies also facilitate personalisation. Freed from the constraints, both physical and interpretative, of the curator and exhibition designer, the learner can use appropriate technologies to provide a dedicated and personal mentor. Examples from a science centre (the Exploratorium) and from an art gallery (Tate Modern) highlight the learning potential of a versatile and mobile information source that is under the control of the learner.

4 ONLINE LEARNING

Museum websites are possibly even more diverse than museums. Apart from obvious differences of content and design, their underlying philosophies and approaches to learning differ considerably, sometimes (but not consistently) reflecting the views of the museum itself. The extremes are represented by the 'interactive reference' type and by creative applications with learner-created outcomes.

The accounts in the literature, although largely descriptive, do give an indication of the types of learning made possible by the variety of websites already on offer. Examples from the major national museums, heritage organisations and other institutions reflect the diversity of approaches, from encyclopaedias to games, but include innovative and imaginative products driven by underlying theory and some that actively encourage participation in knowledge creation.

Webcasts are seen as a way of introducing the human dimension to the digital, as a bridge between on site and online, and as a step from a deficit model of learning towards greater dialogue.

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does learning in museums have a real future – or only a virtual one?

5 THE FUTURE

Museums have already achieved many of their aims in developing digital exhibitions and learning resources. In this limited sense, the aspirations of A Netful of Jewels and Building the Digital Museum have largely been exceeded.

A new set of relationships is emerging, between objects, learners and digital technology, in which museums are, above all, places of exploration and discovery. In the museum of the future, distinctions between real and virtual, already blurred, will matter even less as both museums and learners better understand the processes of inquiry and of learning itself. The real key to future development is likely to be personalisation: of interpretation to significantly enhance social and intellectual inclusion; of technology to free both museums and learners from many of the current constraints; of learning to finally facilitate an escape from the deficit models so prevalent in educational institutions and release untold potential, as the individual learner is able to use technologies to exercise choice and to take responsibility for his/her own learning.

1 INTRODUCTION AND BACKGROUND

Does learning in museums have a real future – or only a virtual one? Should a museum spend its limited resources on providing expensive exhibitions and handling collections (together with appropriate staff) to reach only the limited number of people who are able to – and who choose to – visit its galleries? Or should it utilise the power of digital technologies to reach out to communities well beyond its walls, who, for historical, geographical, or social reasons, will never enter the hallowed halls?

This review aims to address these questions by:

- introducing theories of museum learning and the way these have changed in recent years
- highlighting key trends in the adoption of digital technologies for learning within and beyond the walls of museums
- providing pointers for potential future developments for curators and developers of digital technologies for museum learning.

Before addressing these overarching questions, it is useful first to remind ourselves of the nature of museums, recent developments in museum education and the potential impact of digital technologies, and to gain some notion of the scope and scale of the three-way interface between museums, learning and digital technologies.

1.1 A BRIEF HISTORY

The British Museum recently celebrated the 250th anniversary of its foundation in 1753. The three major national museums in South Kensington – of the physical sciences and technology (Science Museum), the life and earth sciences (The Natural History Museum) and of the decorative arts (Victoria and Albert Museum) – were established there in the late 19th and early 20th centuries. It is worth noting in the context of this long history that it was only in the late Victorian period that school attendance became compulsory, primary in 1870 and secondary in 1902, and that it is merely a decade since UK museums first established a presence on the worldwide web. Our current understandings of both education and of learning with digital technologies can therefore be seen to have emerged long after the original conception of the museum in our society was formulated, and these have had to be incorporated within complex structures that perhaps owe more to history than to logic. This means that the various functions of the museum, collections management, exhibitions, education and website, may well be the responsibility of completely separate departments, with little inter-communication and, possibly, conflicting philosophies.

Once, all was straightforward. Museums collected and conserved artefacts. They exhibited (behind glass) some of these (dusty) objects for the inspiration and edification of the visiting public, accompanied by text labels expressing the antediluvian opinions of expert curators written in an obscure language. This may well indeed remain the popular perception of a museum (Hawkey 2001). Museum educators taught groups of (predominantly) schoolchildren in a classroom space attached to the museum, occasionally borrowing items from the museum's reserve collection – or establishing their own handling collection. The more daring may have occasionally ventured to facilitate some kind of practical learning activity in the hallowed halls of the museum itself.

Eventually, exhibitions began to change. Visitors could not, after all, be expected to learn for themselves, to see the world from the curator's perspective, without support and guidance. A new generation of exhibits – 'with the visitor in mind' (Miles at al 1982) – emerged, in which specialist interpretative devices were utilised to make clear the message that the visitor was expected to heed. Objects became secondary to the message, especially in those museums where concepts can dominate – museums of science, of natural history, of archaeology, of history, perhaps – if not in art galleries. With interpretation predominant, the educator's role became one of compensation, reaching audiences for whom the exhibition offer was inappropriate, such as children (whether in school parties or family groups) or university students and adult education classes.

The widespread development of digital technologies in all aspects of museum operations during the latter part of the 1990s coincided with the start of a different perception of the museum educator. As lifelong learning and access became key targets, so the role of learning specialists began to change. Their audience was seen as very much more than schoolchildren. They were increasingly invited to participate in exhibition development, and this included (often rather more reluctantly) exhibits and activities founded upon digital technologies. In many ways,

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1994 was a key transition year for digital learning in museums, for there were two major developments, apparently independent and unrelated, but that were subsequently to converge. Within the museum, the audio guide, for many years a technological upstart attempting to make an impact, went digital (Proctor and Tellis 2003). And, on 4 July 1994, The Natural History Museum became the first UK museum website to go live, even if the material was initially an online brochure rather than a learning resource (Shaw 1995).

Today, museums provide a plethora of different kinds of learning activities. Anderson (1999) carried out an extensive survey and lists 23 categories, ranging from 'Services for children' (most frequent) to 'Publications and resources for minority communities' (least frequent). It is an indication of the rapid pace of development that, while approaches such as printed/audio-visual information, publications and trails all feature in the list, there is no specific reference to online or other digital provision. However, it requires little more than a cursory glance at the 24 Hour Museum site (www.24hourmuseum.org.uk) or that of its offspring Show Me (www.show.me.uk), to appreciate how rapid and widespread the growth of museum learning opportunities online has been in the early years of the 21st century.

It is perhaps not surprising, but still rather startling, that the pace of development since the mid-1990s has been so rapid. As little as three years ago, the museum community was still busy alerting itself to the fact that it would be necessary to alter its documentation practices to engage and to address the pedagogic needs of diverse audiences (Cameron 2001). The role of the museum both in respect of education, and in respect of its response to digital technologies for learning, therefore, is one which should be seen as emerging within a complex set of sometimes competing objectives. The aim of this review is to step back for a while from these debates and to ask, after ten years of experience in this area, how digital technologies might best be used to support the learning opportunities that museums can offer.

1.2 SCOPE OF THE REVIEW

The focus of this review is on those aspects of learning provided by museums and galleries through the use of digital technologies (Fig 1.1). It does not consider other functions that digital technologies fulfil in the museum sector, such as publicity or administration, except where developments such as collections management systems have a potential impact on opportunities for learning. It is, however, necessary to include some consideration of the wide range of informal learning opportunities that are available through other non-digital modes and media within the museum environment. Similarly, it is not possible to completely isolate learning in museums and galleries from that in other informal situations.

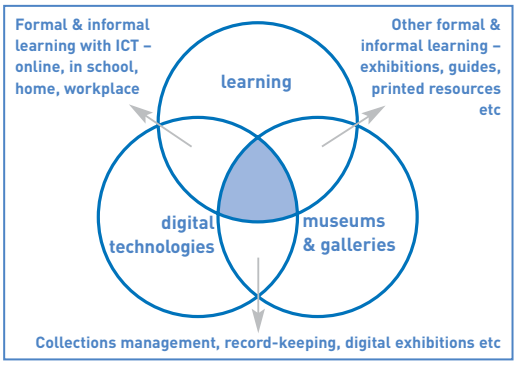

Fig 1.1: Scope of the review

1.3 SOURCES

Literature reviews conventionally concentrate on material published in books and peer-reviewed journals. However, while there is a body of work on learning in museums (see, for example, Hein 1998; Falk and Dierking 2000; Moussouri 2000; Moussouri 2002; MLA 2004) and a rapidly growing literature on the wider use of digital technologies for learning – especially in classrooms – there is little such work available at the intersect of all three domains. (The annual conference Museums and the Web (Bearman and Trant 1999 –2004) does increasingly feature papers relating to learning although the focus remains primarily technical rather than pedagogic.) Work cited in this review therefore includes a number of conference presentations and several online evaluation reports, as well as material produced by museums and galleries themselves and by government and other agencies.

1.4 DEFINITIONS

1.4.1 Museums and galleries

Of course, everybody knows what a museum is. Dictionaries define it as a place where objects important to art, history or science are studied, conserved and displayed. The International Council of Museums concurs, and emphasises collections. These definitions, however, rule out science and discovery centres, which don't have collections (except, it can be argued, of exhibits). And the 24 Hour Museum (www.24hourmuseum.org.uk), which has neither place nor objects. And a gallery? A place where art is exhibited. Yet museums describe individual rooms as galleries, whatever they display, while in science centres they're often halls or simply rooms. And what should we make of the concept of an interactive museum? Is it the case that museums – or at least individual galleries within museums – can either display objects or be full of specially built interactive learning machines?

This is neither mere semantics nor pedantry. It is a reminder that the museum is not a single, homogeneous entity, but a diverse range of institutions with a dual purpose: the creation of new knowledge (research) and its dissemination (education). Once these were intimately integrated, both functions were dependent upon the collections. With the advent of compulsory education, however, learning was seen as the preserve of schools and museums were seen as places merely for the storage of existing (potentially ancient) knowledge (Arnold 1996). Only now in the 21st century does digital technology potentially permit the reunification of these roles.

In this review, the terms museum and gallery are interpreted widely, to include any collection or display with public access, and we use the term museum throughout as shorthand. Although it does not specifically exclude them, there is little emphasis on two particular types of museum where digital technology and learning would be expected to play a synergetic role – as a search engine might identify. One group comprises those museums dedicated principally to the development of computers themselves, eg Heinz Nixdorf in Paderborn (www.hnf.de) or the Computer Museum in Boston, now part of the Museum of Science (www.mos.org/tcm/tcm.html). The other group is of those museums established within and on behalf of

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educational establishments such as universities, rather than for the general visiting public, even though projects such as LEMUR (Learning with Museum Resources, www.abdn.ac.uk/lemur) may prove interesting.

1.4.2 Digital technologies

Digital technologies encompass a wide range of systems and devices, characterised by, but not limited to, the computer. Synonyms abound, such as ICT (=information and communication technology: note the singular) – used in the National Curriculum for England & Wales (DfEE/QCA 2000). Some applications such as databases and search engines make more accessible and more rapid tasks that were hitherto slow and tedious. Many replace previous earlier alternative or analogue versions – animation, audio, film, graphics, photography, television, video etc. Others facilitate essentially new activities that would otherwise be impossible; this is especially true of applications that create material on demand. Table 1.1 presents a summary in relation to learning within the museums/galleries sector.

The **world wide web** provides access to a range of digital resources including online libraries, journals, databases, and datasets, through the internet. Many museums incorporate some type of intranet within exhibitions, to provide a dedicated and limited resource that is functionally similar.	**Simulations and models** allow interaction with and manipulation of real world environments. They permit field trips, experiments and other activities associated with a museum's collection and research that are otherwise impracticable for reasons of time, locality, safety or expense.
Multimedia materials may include graphics, pictures, photographs, animations, film, video, and sound in addition to text and can potentially support a variety of learning styles.	**Microworlds and games** provide an extension of the simulation by incorporating a case study scenario. In these kinds of games, the learner participates directly as a virtual persona (an avatar) rather than as a mere observer.
Computer mediated conferencing (CMC), including e-mail, discussion boards, bulletin boards and chat rooms, used to support many types of discursive or collaborative activities.	**Streaming** digital audio and video delivered via the web can give access to real-life situations.
Presentation technologies, including digital projectors, and may be fully interactive or exclusively unidirectional.	**Visualisation tools** can represent complex sets of data in a visual way.

Table 1.1 Uses of digital technologies for learning in museums/galleries (adapted from glossary in Littlejohn and Higgison 2003)

1.4.3 Learning

The definitions of learning that will be used in this review are discussed in detail in section 2, as in and of itself, the question of how we interpret learning and education is key to developing an understanding of the potential role of digital technologies in the museum sector. For the purposes of defining the scope of this review, however, it suffices to say that a focus on learning in museums requires a wide interpretation of the term and is not confined to the achievement of formal curricular objectives but encompasses the encouragement of a wide range of behaviours, skills, dispositions and experiences.

1.5 ACCESS AND USE: SOME STATISTICS ON MUSEUMS, DIGITAL TECHNOLOGIES AND LEARNING

1.5.1 Museums and their visitors

The rationale for collecting data, the means of collection and the categories used for reporting tend to differ considerably from one museum to another, and even in the same museum over time. Because of this it is not particularly productive to try to draw significant conclusions from the learner numbers across museums and galleries, nor even for different types of activities within museums. However, some trends are evident and tentative inferences can be drawn.

Website	Page impressions	Visitor sessions	Mean visit duration, min
24 Hour Museum	4 040 131	775 457	6.49
Fitzwilliam Museum	1 055 152	210 603	5.18
Imperial War Museum	7 427 122	1 688 396	8.09
National Maritime Museum	6 500 000	1 600 000	9
National Portrait Gallery	5 932 883	1 295 389	6
Natural History Museum	22 344 957	5 790 771	9.02
National Museum of Science & Industry *	9 843 548	2 670 585	7
Tate	32 982 581	4 799 605	6.52

* Science Museum / National Railway Museum / National Museum of Photography, Film & TV

Table 1.2 Museum website visits, 2002 (After 24 Hour Museum 2003)

the question of how we interpret learning is key to developing an understanding of the potential role of digital technologies

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Museum	Physical visitors	Virtual visitors	Physical visitors	Virtual visitors
24 Hour Museum	n/a	775 457	n/a	no data
British Museum	4 813 000	4 491 000	245 000	3 234 000
Imperial War Museum	1 604 353	1 688 396	350 000	included
National Maritime Museum	1 004 604	1 600 000	129 921	no data
National Portrait Gallery	1 484 331	1 295 389		
Natural History Museum	2 196 416	5 790 771	343 877	157 972
Science Museum	1 710 000	1 640 000	554 000	no data
Tate	5 100 000	4 799 605		

Table 1.3 Physical/local and virtual/remote learners 2002
(Data from 24 Hour Museum 2003 and museums' own annual reports)

the number of virtual visitors has already overtaken the number of physical visitors on-site

Some pertinent data are available, principally in the museums' own annual reports – increasingly available online – and, in the case of website visitors, from the 24 Hour Museum. Of these the most useful appear at face value to be those for virtual visitors, but all such data are prone to error, according to what is actually counted as a visit or a visitor. What is evident is that as early as 2002 (the last year for which comprehensive data are readily available) the number of virtual visitors to many museums' websites had already overtaken the number of physical visitors on-site.

Discerning the same relationship between physical and virtual **learners** is much more difficult. Some museums include as virtual learners only those using specifically designed websites, others count virtually every visitor as a learner, while yet others make no distinction between on-site and online learners. Similarly, while many museums report separate figures for schools, for children (other than in school parties) and for adults, the criteria used vary widely. What is clear, however, is that for some museums (and, especially for science and discovery centres) a large proportion of visitors (60% plus) come from the formal education sector – in school parties – whereas for others (especially the largest, national museums) this is relatively small (perhaps 5 – 10%), although still highly significant in absolute numbers.

1.5.2 ICT and learning

Given the increasingly digital offering of learning resources via websites, we need also to attempt to understand the levels of access and use of ICTs outside museums. Again, this is problematic as reliability and currency of figures in this area are hard to determine. However, some statistical studies offer an indication and, certainly, identify trends in computer and internet access. For example, the survey Young People and ICT 2002 (NFO System Three 2003) found that households with access to the internet at home rose from 64% in 2001 to 68% in 2002. 84% of young people (ages 5-18) used the internet at home, at

LEARNING IN MUSEUMS: THEORETICAL PERSPECTIVES

school or elsewhere, compared with 73% in 2001, with computers generally being used for a wide range of activities.

It is worth noting Resnick's (2002) optimistic view that, "The declining cost of computation will make digital technologies accessible to nearly everyone in all parts of the world, from inner-city neighborhoods in the US to rural villages in developing nations". Despite this suggesting that levels of ownership and use will increase across all sections of society, social class remains the single most significant factor in availability and usage.

1.6 SUMMARY

Despite their current diversity and the multitude of changes, especially in response to the introduction of digital technologies, museums and related heritage institutions share enormous potential as learning facilitators. For while education was once seen as a peripheral activity and technologies as a threat to their very existence, both have now become central to the mission of 21st century museums, both on-site and online. The multidimensional and truly multimedia nature of museums invests them with significant advantages over other learning providers, both formal and informal. How they respond to the challenge depends to a considerable extent upon their perceptions of their role in relation to visitors and to learning itself.

2 LEARNING IN MUSEUMS: THEORETICAL PERSPECTIVES

There are a number of key tensions – or, at least, questions of balance – evident in the provision of learning opportunities in museums.

The first tension is between different learning philosophies: should museums offer delivery or engagement; should the underpinning rationale be a passive/transmission view or an active/constructivist view?

Second is the question of the audience – how should museums cater for formal educational needs and/or for informal learning by the general public? Many smaller museums, together with many science and discovery centres are highly dependent upon the formal education sector – school parties – for their audiences (and, critically) for their income. In contrast, the larger museums, especially the national museums in London, cater for significant numbers of the general public, children and adults, from the UK and beyond.

The third balance is effectively about resources and impact and concerns the balance to be struck between effort expended upon the physical, on-site galleries and the virtual, online offer.

This section considers the first two of these questions, focusing on the very nature of learning, its various manifestations – in museums, with computers and other digital technologies, as lifelong learning – and the recent movement towards learning objects. The third question is discussed in sections 3 and 4.

museums and related heritage institutions share enormous potential as learning facilitators

LEARNING IN MUSEUMS: THEORETICAL PERSPECTIVES

2.1 A MUSEUM OF LEARNING?

"Suppose that we were commissioned to create a museum of learning..." Thus begins Howard Gardner's recent polemic on what is known about learning – and what remains as yet unknown (Gardner 2004). He concludes that there would be much of interest on display, but that there would be several empty rooms. He might well have added that the digital equivalent, the virtual museum of learning, would frustratingly balance myriads of fascinating hyperlinks with numerous error messages and unavailable pages. And, as Falk and Dierking (2002) have cogently observed, most of what is known about learning is based on studies from either classrooms or psychology laboratories and so may be inappropriate as a basis for considering learning outside of these settings. Much has been done in this area, but much remains to be explored, particularly in non-school settings.

2.2 FORMAL/INFORMAL LEARNING

In the museum domain, 'learning' is used with a considerable range of meanings. For some it may simply mean access to and acquisition of knowledge. For others its principal focus is the provision of resources intended for schools. The approaches to learning may differ. The subject matter may vary. The audience may have a different composition. But whether science centre, art gallery, natural history museum, local/regional museum or whatever, every museum has an apparent desire to put learning high on its agenda.

In recent years it has been seen as important to distinguish between formal education – often perceived as being equivalent to schools and the curriculum – and informal learning – as befits adults and others not tied to the classroom (many museums renamed their Head of Education as Director of Learning). Yet it is far too simplistic to assume that learning is either formal or informal. At the very least, both learner affiliations and teaching/learning activities may each be divided into formal and informal, providing a two-by-two matrix. One example of each of the four categories is shown in Table 2.1.

		Activity	
Affiliation		formal	informal
	formal	Lectures for groups of students	Free-choice exploration of exhibits
	informal	Adult education courses	Interactions with gallery characters

Table 2.1 Simple analysis of formal/informal learning in museums

There has certainly been much debate about the relationships between the informal and formal learning domains. The US National Science Foundation has funded the establishment of the Centre for Informal Learning and Schools, a collaboration between the Exploratorium, the University of California Santa Cruz and King's College, London. Others, such as Falk and Dierking (2002) argue passionately for the use of 'free-choice' learning to describe the kinds of approaches to learning that occur in museums and elsewhere outside the school and college system.

At the very least, this increased attention to and valuing of informal learning helps to challenge a number of narrow perceptions about the location, nature and purpose of learning in general:

- that learning is principally an activity confined to schools
- that learning, while worthy, is essentially dull
- that learning requires a defined curriculum
- that learning requires the acquisition of a body of factual knowledge, of which learning names is a primary objective
- that learning involves the transmission of knowledge from teacher to learner.

At the same time as there is increasing attention paid to informal learning, however, it is important to acknowledge that the meaning, forms and purposes of 'formal' learning are also themselves undergoing revision, as Resnick (2002) argues:

"We need to transform curricula so that they focus less on 'things to know' and more on 'strategies for learning the things you don't know.' As new technologies continue to quicken the pace of change in all parts of our lives, learning to become a better learner is far more important than learning to multiply fractions or memorising the capitals of the world."

Or, he might have added, knowing the names of objects in a museum display...

The recent initiative by the Museums, Archives and Libraries Council has focused on the ways in which museums can attempt to measure the learning that takes place within their galleries – and on their websites. The essence is that museums and galleries should not be limited in their work by their relationship with formal learning, but should celebrate informal learning outcomes as being important in their own right (MLA 2004).

While the state of play of knowledge about learning may be far from complete, what is clear is that the present period is characterised by a re-evaluation of the scope, nature, location and purposes of learning, much of which is triggered by the opportunities or challenges offered by digital technologies, and by a renewed interest in learning across institutions, rather than simply confined to schools.

For example, in recent years we have witnessed the emergence of the debate on the role of museums in supporting lifelong learning. In the UK the political establishment has increasingly advocated a wide-ranging agenda for lifelong learning, much of it linked to employment-related issues, and to the development of specific vocational skills, principally for economic motives. Museums can clearly engage learners in creative and cultural pursuits as well as more vocational aspects of learning – and certainly well beyond improving schoolchildren's performances in examinations. Much of the focus of many lifelong learning initiatives is on ICT, and this provides an additional opportunity for museums and galleries to fully commit themselves to the learning enterprise, for, as Resnik (2002) reminds us:

"In the digital age, learning can and must become a daylong and lifelong experience. National education initiatives should aim to improve learning opportunities not only in

museums and galleries should celebrate informal learning outcomes as being important in their own right

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schools, but also in homes, community centers, museums, and workplaces."

2.3 THEORIES OF LEARNING IN MUSEUMS

2.3.1 Beyond factual recall

There are many theories of learning, some apparently more applicable to informal learning in general and to museums in particular, some seemingly more relevant to the use of digital technologies. Many of the best-known models provide useful insights, at least into identifying issues worthy of consideration. In recent years museum learning has been the subject of considerable attention: reports (eg Anderson 1999), initiatives (eg Resource 2001; MLA 2004), books (eg Hein 1998; Falk and Dierking, 2000) and research studies (eg Moussouri 2002; Hooper-Greenhill et al 2003). Although the motives, perspectives and terminology may differ, the broad conclusions are surprisingly similar.

the museum experience can stimulate most of the different types of intelligence

It is almost half a century since Bloom and his colleagues published taxonomies of educational objectives. Learning, they suggested, can occur in any or all of three domains: cognitive, psycho-motor and affective. (The formal sector, we might observe, traditionally emphasises the former while museums and galleries have significant potential for the latter.) Furthermore, within the cognitive domain, factual recall (including technical terminology) is the lowest of six levels. It is worth observing that despite this, and fifty years on, school league tables are based primarily on the outcomes of standard assessment tasks, universities are criticised for too much emphasis on factual recall, knowledge quiz games feature heavily on radio and TV, while museums and galleries continue to transmit the knowledge of expert curators to their passive visitors (Hawkey 2001).

Beyond Bloom, Gammon (2001) has suggested a five-category taxonomy of museum learning experiences: cognitive, affective, social, skills development and personal. Recent work at the University of Leicester (Hooper-Greenhill et al 2003) has generated a similar set of five areas:

- knowledge and understanding
- skills
- values and attitudes
- enjoyment, inspiration and creativity
- activity, behaviour and progression.

These analyses share much with Gardner's theory of multiple intelligences. His seven types are:

- logico-mathematical
- linguistic
- spatial
- musical
- kinaesthetic
- intra-personal
- inter-personal.

Less well known is Gardner's advocacy that all schoolchildren should experience museum learning in addition to – or, even, in place of – classroom learning. The richness of the museum experience, he contends, is that it can stimulate most of the different types of intelligence, while traditional classroom learning tends to concentrate heavily on a more limited range, principally linguistic (Gardner 1991). (Note that MLA's Inspiring Learning for All website – www.inspiringlearningforall.gov.uk – carries a quiz based on Gardner's theory.)

A somewhat different, but interesting approach is found in Perry's (2002) analysis of informal learning (defined as 'intrinsically motivated, non-linear and self- directed'.) She highlights four 'types' of learning, the majority of which lie broadly in the affective domain:

- sparking an interest
- delayed learning
- visceral learning
- wrap-around learning.

Although the terminology may be different, these categories echo much recent work on free-choice learning in museums and elsewhere (Falk and Dierking 2002).

All of these considerations fit well with the much wider – and richer – definition of learning adopted by the Campaign for Learning. The essential elements of this definition are its breadth of scope and its proposition that learning is an active process that results in changes in the learner's cognitive structures:

"Learning is a process of active engagement with experience. It is what people do when they want to make sense of the world. It may involve the development or deepening of skills, knowledge, understanding, awareness, values, ideas and feelings, or an increase in the capacity to reflect. Effective learning leads to change, development and the desire to learn more." (CLMG 2000)

This active process is characterised by Sharples (2003) as "construction, conversation and control", in his 3 Cs of effective learning. Effective learning, he argues,

"involves constructing an understanding, relating new experiences to existing knowledge. Central to this is conversation, with teachers, with other learners, with ourselves as we question our concepts,

learning is a process of active engagement with experience

		Learning style			
Component		Accommodator	Assimilator	Converger	Diverger
	Concrete experience:	✔			✔
	Observation and reflection		✔		✔
	Concept formation / generalisation		✔	✔	
	Testing concepts in new situations	✔		✔	
	In museum exhibitions... (Serrell 1996) Prefer...	imaginative trial and error	interpretation that provides facts and sequential ideas	to try out theories	interpretation that encour ages social interaction
	Look for...	hidden meaning	intellectual comprehension	solutions to problems	personal meaning

Table 2.2 A summary of learning styles arising from Kolb's learning cycle

LEARNING IN MUSEUMS: THEORETICAL PERSPECTIVES

and with the world as we carry out experiments and explorations and interpret the results. And we become empowered as learners when we are in control of the process, actively pursuing knowledge rather than passively consuming it."

Another model that has been used to support the design of museum exhibitions for active learning is that of learning styles. Kolb's experiential learning model describes four dimensions in a learning cycle: immersion in concrete experience, followed by observations and reflections, then logical or inductive formation of abstract concepts and generalisations, and, finally, empirical testing of the implications of concepts in new situations. Learners, it is suggested, favour two of these, each pair identified as one of four fundamental learning strategies. Table 2.2 summarises these and their possible implications for learning in the museum. Recent exhibitions at the V&A – Silver Galleries and the British Galleries – have drawn on such approaches (Hinton 1999; Durbin 2002).

2.3.2 Knowledge, objects and free choice learning: the USPs of museums

Knowledge

However important the affective and social dimensions of learning may be, it is nevertheless important not to overlook the cognitive. After all, museums have a long tradition as repositories, not just of objects, but of the knowledge associated with those objects. George Hein (1995, 1998) has helpfully distinguished between theories of knowledge and theories of learning in the museum context; both are pertinent. An extreme view of knowledge sees it as absolute, as revealed truth. The contrasting epistemological view regards knowledge as the creation of the human mind and therefore transitory (Kuhn's 'current paradigm'). Similarly, theories of learning show a simple dichotomy between, on the one hand, the view that learning is simply added to a passive tabula rasa (clean slate or empty vessel) and, on the other, the view that new learning is actively assimilated into existing structures by the learner. These contradictory perspectives therefore offer conflicting views of the status of the knowledge held by the museum, and competing ways for learners to engage with that knowledge.

Hein's analysis offers a distinction between the two types of constructivism – knowledge and learning – to produce four domains (see Fig 2.1). Examples can be cited of museum exhibitions, both real and virtual, where these domains are in evidence, whether by deliberate intent or by chance. For example, analysing the website of the Natural History Museum through Hein's model enables identification of clear representations of each of these types, including the

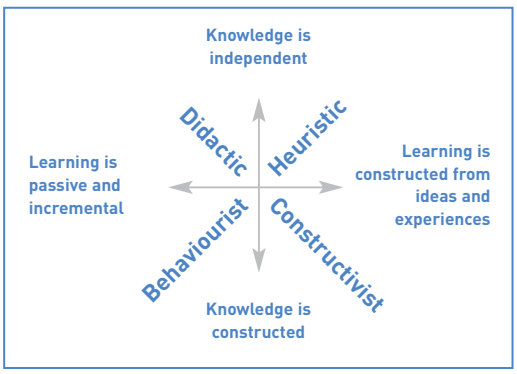

Figure 2.1 2D model of knowledge and learning (Hein 1995, 1998)

we become empowered as learners when we are in control of the process

Personal	Social/cultural	Physical
self-motivating, emotionally satisfying, personally rewarding	knowledge is shared within communities	learning is situated
meaningful, choice and control, appropriate level	learning is distributed meaning-making	all learning is influenced by awareness of place
learning is not just cognitive	narrative is powerful	
new learning builds upon existing needs context / framework		

Table 2.3 Contexts applicable to museum learning (after Falk and Dierking 2000)

behaviourist Science Casebook, the heuristic Earth Lab and the constructivist Quest (Hawkey 2002). (See section 4 for a more detailed look at Quest.)

Objects

It is the objects themselves, however, that provide the unique learning potential of any museum, to foster active inquiry-based learning – learning from objects rather than simply learning about them. Activities based on objects: artefacts, works of art, scientific specimens, documents etc allow the learner to explore the many stories and interpretations that they offer.

Free choice and motivation

Museums also provide a free-choice learning experience, so motivation is key in effective learning; experiences should be stimulating, enjoyable, relevant and appropriate for the visitor. Interdisciplinary approaches are more likely to access the prior knowledge necessary for new learning to become established as new links are created and new understandings constructed. Intellectual progression should be provided within particular programmes and within the museum context as a whole, such that visitors are challenged, stimulated and can develop. Within a theory of learning in which the learner is viewed as actively constructing knowledge, the social, personal and cultural context of learning becomes increasingly significant, as Falk and Dierking's (2002) analysis (Table 2.3) summarises.

To facilitate the richness of the experience, the task for museums is to create a context for the learner, to structure and coordinate a range of meaningful choices, through appropriate orientation, signposting and navigation in order to provide the essential elements of museum learning: access to knowledge, enjoyment, awe and wonder – a cultural and social context in which to appreciate the value of the real and unique (Resource 2001).

Appreciation of the learning strategies and needs of the wide variety of museum learners means that there cannot be a single, simple approach. Johnson and Quin's (2004) checklist of recommendations for exhibitions recognises this:

- have many entry points, and no specific path, start, or end
- employ a wide range of active learning media
- present a variety of perspectives

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real progress will be limited until learning is widely regarded as much more than the acquisition of a body of knowledge

- enable visitors to engage with objects (and ideas) through a range of activities and experiences
- provide experiences and materials that stimulate participants to experiment, conjecture and draw conclusions.

2.4 ICT AND MUSEUM LEARNING

"The limitations of computer-assisted learning lie in our ability to understand the learning process, and not in the ability to develop the technology appropriate to any learning situation." (Tawney 1979)

The accelerating development and influence of ICT has generated within the education community three distinct perspectives on e-learning. One is concerned almost exclusively with technical issues. The second sees ICT predominantly as a means of delivering conventional content, effectively unchanged, more quickly, more efficiently and to a much wider audience. The third takes a more radical stance and regards advances in ICT – with its powerful potential for democracy and differentiation – as a catalyst for a fundamental reappraisal of the whole enterprise of education.

Many myths persist about the role of ICT in learning (Hawkey 2001), and these can be as powerful in museums and galleries as they are in schools. Real progress will be limited until learning is widely regarded as much more than the acquisition of a body of knowledge. Even in the informal learning sector the notion of a necessarily prescribed 'curriculum' remains strong, with learning seen as the transfer of knowledge from expert to novice, with ICT as a vehicle for state-of-the-art information delivery. The final myth is that assessment requires but a simple measure of the knowledge deficit – "Why not," enquired a government minister of a museum's Head of Learning, "test visitors' knowledge on entry and then test them again when they leave?"

The online museum offers a tantalising, seductive prospect for learning. Within a few years, suggests Anderson (1999), museum learning could become ubiquitous, reaching every home, workplace and educational institution. Learners can choose where and when they learn, both individually and socially. New kinds of learning – not necessarily better or worse, but certainly different, become possible. Moreover, learners can be stimulated to enhance their virtual experiences with a visit to the real thing, to engage directly with authentic objects. But, for all the talk of innovation and excitement, caution is counselled. After all, much digital learning material is impoverished – imaginatively, aesthetically, symbolically and educationally (Anderson 1999). And there are more fundamental issues.

Knell (2003) highlights a number of questions concerning the relationship between museums and digital technologies. Firstly, he is anxious that developments such as those evident in DigiCULT (European Commission 2002) are being led primarily by technologists, rather than by museologists. (Nor, we might add, are they necessarily influenced by educationalists.) Secondly, and more fundamentally, he questions whether a digital exhibit, however much it can be manipulated, can ever offer anything approaching the real museum experience: "The emotive experience of seeing the real

requires the real and no surrogate will do. A virtual visitor may understand the thing better and be better prepared to interpret it when they see it but they may receive those peculiar attributes of real things only through real world engagement" (Knell 2003). That haptic technologies – 3D virtual reality – may one day give a sense of tangible reality he dismisses, at least for the time being, as "simply an illusion". More credence is attributed to wireless technology and the handheld PDA, in potentially turning museums into inclusive spaces. Some examples, including the Tate Modern's successful foray into this domain, are considered in some detail later (section 3).

Learning is, of course, both process and product. Historically society has paid more attention to the product – and, especially, to its assessment. One of the anticipated consequences of e-learning is a shift in emphasis towards process (Resnik 1999; Hepple 2000). It is, therefore, important that attention is paid to the learning process, rather than solely to the technical aspects of computer-based exhibits: did it work? was it robust? For example, while the Science Museum's guidance for developers points out that the major difference between general multimedia development and developing a computer exhibit lies in evaluation, it makes no specific reference to learning (Science Museum 2003).

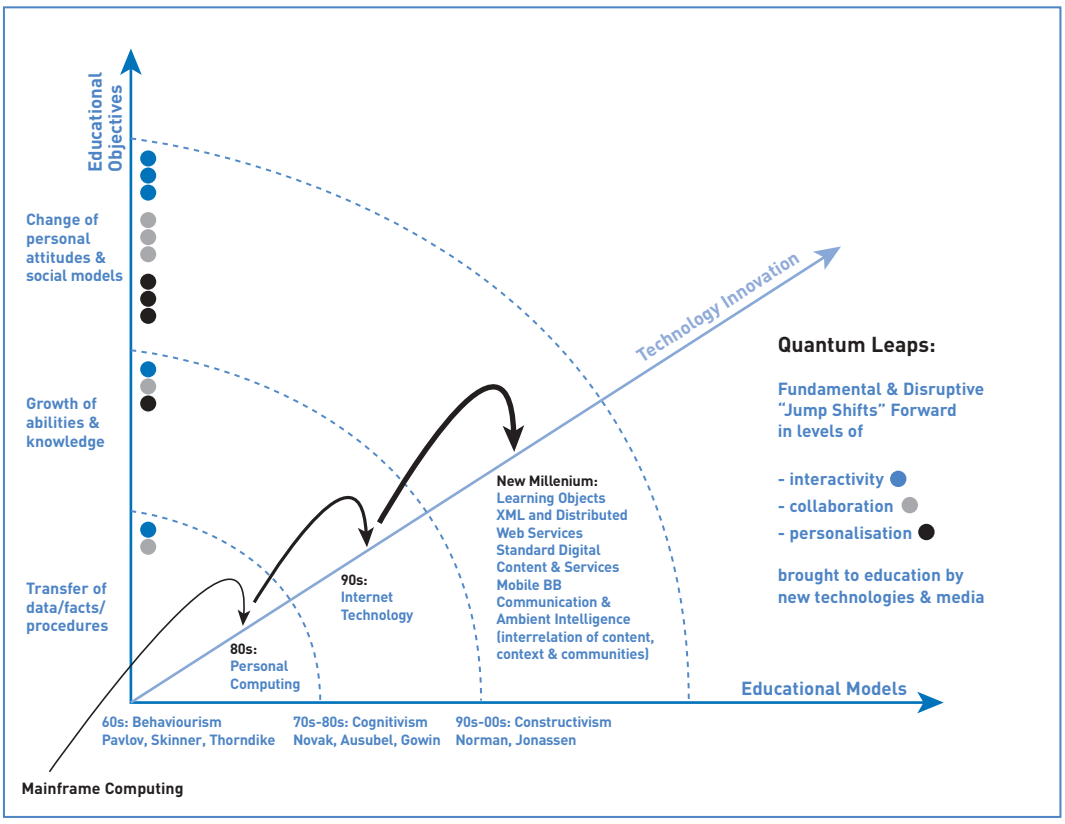


Figure 2.2: Quantum leaps in educational technology (Giorgini and Cardinali 2003)

LEARNING IN MUSEUMS: THEORETICAL PERSPECTIVES

Geser (2003) is rather dismissive of museums' attempts to foster e-learning:

"As part of their mission, heritage institutions usually have the goal of supporting educational activities through providing access to their resources. However, these resources are most often presented only as collection objects, deemed to be useful for 'informal' learning in some way or other (ie usually not further specified)."

The need, he argues, is for "high-quality, standardized learning objects" and this will only be achieved by a strong collaboration between the heritage and e-learning sectors. This will enable institutions to "unlock the richness and diversity of Europe's cultural and scientific heritage for e-learning" (Geser 2003). While Geser focuses largely upon the technical aspects of learning objects, Giorgini and Cardinali (2003) consider the educational implications. Their summary of developments – quantum leaps in educational technology (Fig 2.2) – is particularly interesting.

However, Giorgini and Cardinali's suggestions for the components of virtual learning environments (VLEs) seem to resonate much more closely with formal education systems than with the kinds of informal learning that occur in museums. Their emphasis is principally on organisation and management: curriculum mapping, tracking students, assessment and recording against pre-fixed objectives. Such elements do not immediately appear to fit well either with the kinds of free-choice learning offered by museums nor with the aspiration of differentiation by learner choice afforded by digital technologies. However, rather than accept a mis-match, the assertion is that heritage institutions must adapt, by adopting narrow learning objectives and assessment mechanisms. One might ask whether this is really appropriate.

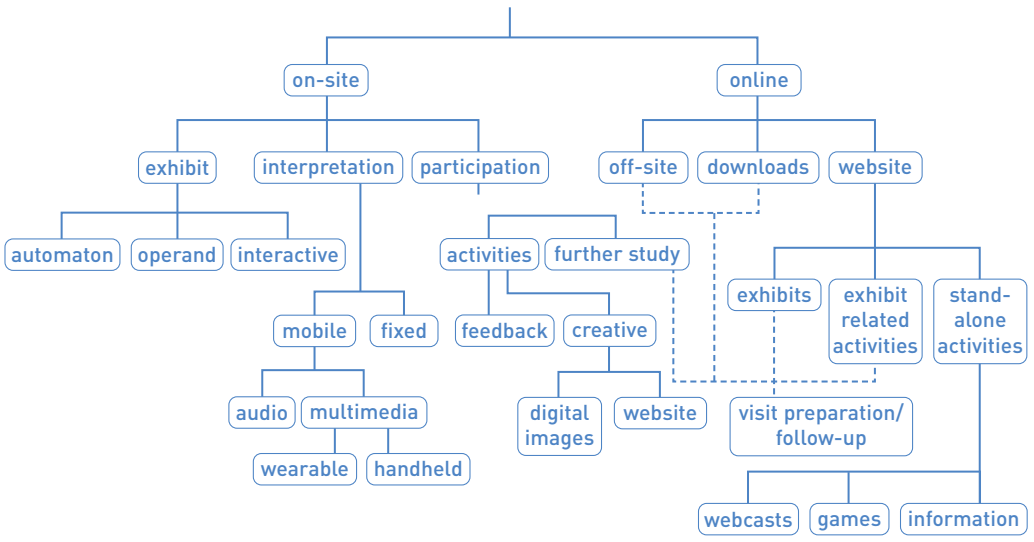
From a theoretical perspective, however, there are a number of ways in which learning with ICTs could and should map onto the educational agenda of museums. Sharples, for example (2000) has identified the correspondence between features of lifelong learning and those of digital technologies, as shown in Table 2.4. Hawkey (2001) has suggested ways in which learning with ICT is much closer to informal learning than to formal (school) learning, in that motivation is intrinsic and that much of the decision-making (content, location, timing, learning style) is in the control of the learner. Hilda Hein's observation about the advantages of museums over schools could equally be applied to learning with computers:

Lifelong learning	New technology
individualised	personal
learner-centred	user-centred
situated	mobile
collaborative	networked
ubiquitous	ubiquitous
lifelong	durable

Table 2.4 The match of digital technology to lifelong learning (Sharples 2000)

"In contrast to classroom routines or film or television programs, museums offer the learner the opportunity to stop at will, to loiter and repeat, to ignore what does not stimulate, and to share what seems interesting." (Hein 1990)

Figure 2.3: Taxonomy of museum learning opportunities with digital technologies



At the same time, several authors have pointed out that e-learning opportunities are severely restricted in the formal education sector:

"A dilemma at the heart of networked learning is that learners can command an increasingly sophisticated set of communication and computing devices, which they are forbidden to use within formal education because they disrupt lessons and lectures. Meanwhile, schools, colleges and universities are starved of IT resources, and in many cases are failing to make best use of those resources they have." (Sharples 2003)

Others have warned that schools may be "using tomorrow's technology to deliver yesterday's curriculum" (Hepple 2001). It is therefore not beyond the realms of the imagination to envisage a situation where schools become heritage sites (transmitting a fossilised curriculum), while museums present innovative alternatives using digital technologies (Miller and Clay 1999).

Although museums are conventionally rather conservative and have varied in their willingness and ability to adopt new approaches, there have already been many rapid advances. Fig 2.3 indicates something of the diversity of ways in which digital technologies are already being used for learning in museums, galleries and science centres.

2.5 SUMMARY

There is increasing recognition that learning should not be conceptualised as the transmission of a fixed body of knowledge to a passive recipient. Instead, learning is conceived as an active process in which learners, through conversation,

ON-SITE LEARNING

rather than replacing objects, digital resources have come to be used to facilitate more than 'interaction'

communication and control, appropriate knowledge, understanding and changes of perspective within their existing structures. This suggests a need to pay attention both to what learners bring to the situation, and to the contexts within which they learn.

At the same time, research into informal (or free choice) learning has identified the importance of learning that has not hitherto been recognised within formal education, encouraging emphasis on multiple intelligences and on skills and attitudes rather than simply cognition. The renewed attention on learning as 'lifelong' and as occurring outside as well as within the walls of the school, offers an opportunity for museums to revise and develop new approaches to learning that are not wholly focused on a formal set of changing curriculum objectives.

The recent emergence of learning objects as a focus for the development of digital educational resources by museums raises some concerns, given its focus on achieving the goals of formal education. Equally, the inconsistent quality of digital learning resources to date, and their reliance on delivery and deficit models also raises concerns. Research in both the museums sector and in educational technology, however, would suggest that there is a synergy between the goals of a free-choice active learning environment and the characteristics of digital technologies that should see museums well placed to take advantage of these new technologies in achieving their educational objectives.

3 ON-SITE LEARNING

'The future of education in museums: will it be real?' asked a recent international conference. Does the way ahead lie with museums' unique position in holding and displaying real objects or in reaching newer and larger audiences through the provision of electronic access? Not so long ago many museum staff feared that digital technologies would replace objects, as interactive exhibits provided possibilities for display – and for learning – not previously available. This section, focusing on digital resources within the walls of the museum, will discuss how, rather than replacing objects, digital resources have come to be used to facilitate more than 'interaction', enabling participation, collaboration and, most excitingly, the provision of personal and individual mobile learning experiences.

3.1 OBJECTS AND INTERACTIVES: USP OR ISP?

If objects, and the knowledge associated with them, are the unique selling points of museums, then why are many museums so committed to digital technologies that they barely stop short of becoming internet service providers? (Several do, indeed, operate an effective on-site intranet.) Why has there been an apparently relentless search for the supposed Holy Grail of interactivity? Can it really be the case that, "both 'interactive' and 'virtual' have become 'so embedded' that there is little debate over their value or utility" (Hemmings et al 2001)?

There are three fundamental questions to consider. Is there a conflict between objects and interactives? What does

'interactive' mean in the museum context? Are the learning issues that arise from mechanical, hands-on exhibits in museums and in science centres the same as those emanating from interactives incorporating digital technologies?

For some, interactivity and objects appear mutually exclusive. Boon (2000) is adamant that the two realms are distinct and should remain so:

"... placing a computer screen in the midst of an artefactual display can be highly distorting of visitor experience, as 'doing the interactives' can tend to overwhelm the slower, more complex, less controllable, forms of interaction which occur with visitors' informed, or simply curious, mental interaction with artefacts and display."

Such a perspective seems rather simplistic, even primitive, in its inherent assumptions about visitors and their learning strategies. In their seminal work, Miles et al (1982) classified exhibits as static or dynamic, the latter subdivided into three categories: automaton; operand; [truly] interactive. Truly interactive exhibits, they argue, require some kind of decision-making by the visitor, compared with those, however technologically sophisticated, that require little or no visitor input beyond start/stop. This crucial requirement of user engagement echoes with Gregory's (1989) demand that science centre exhibits be 'minds-on' as well as hands-on. Such a requirement would limit Hall's (2004) criticism of the kind of 'interactive' exhibit where the visitor "does little more than watch video clips or read text". Not that choice and decision-making are by themselves any guarantee of a learning opportunity, for, as Knell (2003) asserts, there may be, "no logical point to the interaction and no relationship between action and outcome."

As Heath and vom Lehn (2002) point out, the term 'interactive' is misleading, managing to encompass,

"an extraordinary range of tools, technologies and techniques, objects and artefacts that are designed to create interactivity in museums and galleries. It includes sophisticated information systems that prescribe complex forms of interaction between the user and the exhibit through to 'low-tech' artefacts designed to enhance visitors' understanding of particular objects. Different 'interactives' engender very different forms of interaction and provide highly variable opportunities for co-participation and collaboration. As yet we know little of the conduct and collaboration that different 'interactives' afford, still less of the ways in which they might contribute to learning."

So, how are we to identify interactive exhibits? Caulton (1998) gives a definition of 'interactive' that provides a useful starting point:

"A hands-on or interactive museum exhibit has clear educational objectives which encourage individuals or groups of people working together to understand real objects or phenomena through physical exploration which involves choice and initiative."

This, with appropriate modification to remove the requirement for real and physical, will serve well as a definition in the digital realm. Although primarily concerned with mechanical devices, there are features of their analysis that, when

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the problems posed by developing an interactive museum gallery are similar to those encountered in the virtual realm

applied to digital technologies, can remind us of key issues. (It certainly eliminates the mere act of pushing buttons or of clicking a mouse, that some museums have mistaken for interactivity.) Although, as identified earlier, there may be worthwhile learning outcomes other than understanding, the emphases on clear educational objectives, on choice and initiative and on the social dimensions are especially welcome.

The critical role of the social dimensions of interactivity is highlighted by Heath and vom Lehn (2002). For them, it is the learners who are interactive rather than the exhibit. Their Wellcome Trust-funded study of interactives in science museums highlights many of the false assumptions inherent in many interactive galleries. Museum visitors, they observe, rarely behave in ways that exhibition designers anticipate; they follow neither the sequence nor the pace intended.

This leads us to consider the nature and context of interactive exhibits. Bradburne (2001) distinguishes forcefully between an exhibition and an informal learning environment. The former, he contends, is designed to "broadcast facts", the latter to "support action (or, better, interaction)". If learning is associated with sustained engagement then exhibits would structure and sustain interaction between users, rather than attempt to demonstrate principles. Such an approach conflicts with that of Gilbert and Stocklmayer (2001). While recognising the need for entertainment and for opportunities for learners to build upon pre-existing understanding, their focus is primarily upon the exhibit as a (more or less) effective way of conveying scientific principles.

Taking an apparently similar perspective, in that the sessions that they describe are designed to lead to the acquisition of a single right answer and its accepted explanation, Hemmings et al (2001) report an ethnographic study of the Magician's Road gallery at the National Railway Museum. The exhibition itself, a 'mélange of apparatus, representation, texts and physical artefacts' is taken to be an analogue of a digital, hypertext website and leads them to conclude that, in terms of 'providing pathways through information', the problems posed by developing an interactive museum gallery are similar to those encountered in the virtual realm. This may well be the case. However, the nature and focus of the interactives they chose may provide little insight into more open-ended or enquiry-based learning whether in or beyond the museum setting.

This is where the real conflict lies, between fundamentally different philosophies of the relationship between museum and visitor. How are learners treated? Are they seen merely as passive recipients of the expert knowledge and opinions of the curator? Is there emphasis on transmitting knowledge or on fostering inquiry skills? On providing answers or on promoting questions? Is there active engagement with objects or other materials? Is there real learner choice?

3.2 PARTICIPATION

Resources that enable visitor participation have the potential to offer a more complex version of interactivity. In museums this can vary from what is essentially a simple yes/no vote – eg Antenna in the Wellcome Wing of the Science Museum – to creating

a digital record of oneself for subsequent retrieval. The museum's In touch site allows the visitor to make his or her own web page and to access this after the visit. (Such is the popularity of this interactive activity that by 1 April 2004, over 200, 000 personal web sites had been created.) This is also a feature of At-Bristol's Get Connected (www.at-bristol.org.uk/explore/connected.htm), where visitors can compare their ideas on a variety of topics from cloning endangered species to using robot cleaners.

In many museums of science and technology – and, certainly, in science centres – the axis of learning has shifted from the deficit model to one of dialogue. Learner participation is central to this change of emphasis. An example, which also highlights pan-European collaboration, is Bionet (www.bionetonline.com), in which both At-Bristol and the Science Museum are partners. Accessible online in nine languages through the websites of eight museums and science centres, Bionet facilitates exploration and debate about current developments in biotechnology. Fundamental to the approach is the incorporation of ethical and legal aspects in addition to the science, but it is the capacity for users to express opinions and to argue with each other as well as with experts that makes the project distinctive.

The Victoria and Albert Museum has experimented with a number of projects in which family learners were encouraged to engage with exhibits by creating their own digital images. Key to the success of the Canon event was visitors' appreciation that, through learning new skills, they could themselves create their own masterpieces to stand – at least, virtually – alongside those in the exhibition. Photo-montage and collage techniques were applied to the digital images from around the museum, displaying themes and inter-relationships chosen by the visitors as learners rather than by the curators as experts. Wish.you.were.here was a similar project in which visitors learned to use a digital camera and graphical editing software. The work appeared as digital postcards, e-mailed to friends and family or subsequently accessed on the museum's website.

Durbin (2004) suggests going much further than mere participation. "You don't have to sweat it out over all your content if you are prepared to allow visitors to generate it for you", she asserts. She cautions against the tendency for museum curators to communicate in one direction only, but affirms that the V&A is "keen to ensure the site works in both directions" and that it draws "on the expertise and enthusiasm of visitors as well". In this way, visitors to the website will feel they can contribute to the work of the museum while developing their own creativity.

in many museums of science and technology, the axis of learning has shifted from the deficit model to one of dialogue

3.3 COLLABORATION

One of the powerful features of digital technology is the relative ease with which collaboration becomes possible. Learners benefit from seamless access to resources and ideas from other areas, both geographical and conceptual – and to other learners.

The collaborative aspects of learning are generally high on the agenda in the museum context. Galani and Chalmers (2002) report an innovative study involving a three-way collaboration between real

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learners (actually present in an exhibition), virtual learners (online) and a third group in a 3D virtual reality environment. Their work explores the social context of learning in a way that bridges or blurs the boundaries between visitors who are local and remote, and between digital and physical. The intention is that learners will be able to create associations within a museum collection and between collections, and that those associations will form a resource not only for subsequent visits, but also for the visits of others.

The STEM project (www.sciencemuseum.org.uk/education/stem) encourages visitors to the physical museum or to its website to share their ideas on the educational use of the National Museums of Science and Industry, which are published on the web (Bazley 1998). For students it is a way of 'promoting deeper reflection on the visit than might otherwise take place', and many of the sites created are 'superb educational resources in their own right'. Teachers can produce valuable guides and resources for other teachers using the museums, including one for the Magician's Road gallery, referred to above. Further collaborations with US teachers and the Franklin Institute in Philadelphia indicate the potential for crossing boundaries in work of this type. Elinich (2004) describes the Franklin Institute's project Keystone Online, in which research-based activity kits and professional development opportunities combine with a dedicated website to facilitate inquiry-based science teaching.

3.4 PERSONALISATION AND MOBILITY

Learning in museums and galleries has been supported by electronic technologies for over forty years, since the first audio guides were developed – firstly reel-to-reel tape, then cassette and, now, digital systems (Proctor and Tellis 2003).
The introduction of digital technologies represents not simply a further enhancement in sound quality, nor merely the additional possibilities of multimedia. The key factor is the offer of a totally new learning experience, based upon apparently unlimited choice and freedom. Flexibility is crucial, enabling learners to select their own pathways and pacing.

Underlying museums' use of such approaches are both practical and philosophical perspectives. Sharples (2000) has developed a 'theory of lifelong learning' mediated by handheld and wearable technology, considering hardware, software, communications and interface design. Devices must be:

- highly portable, so that they can be available wherever the user needs to learn
- individual, adapting to the learner's abilities, knowledge and learning styles and designed to support personal learning, rather than general office work
- unobtrusive, so that the learner can capture situations and retrieve knowledge without the technology obtruding on the situation
- available anywhere, to enable communication with teachers, experts and peers
- adaptable to the learner's evolving skills and knowledge

- persistent, to manage learning throughout a lifetime, so that the learner's personal accumulation of resources and knowledge will be immediately accessible despite changes in technology
- useful, suited to everyday needs for communication, reference, work and learning
- intuitive to use by people with no previous experience of the technology.

Two approaches in current use are handhelds and wearables. Both offer the potential of an individualised approach to learning, differentiated – at least to some extent – by learner choice. Indeed the differences between the two systems are largely ergonomic rather than conceptual, relating principally to portability and visual display. Either can carry data in on-board memory or by accessing a virtual network; both can be triggered by the learner and/or by sensor systems in the museum's exhibits. As Hepple (2000) reminds us, within months (rather than years) the majority of those who enter the physical space of a museum will be carrying their own digital communications device. Wireless networks are already in place in many public spaces. Educators have begun – perhaps a little tentatively – to embrace the technology, rather than to deny its existence or to prohibit its use.

Sparacino (2002) describes a study – with a wearable/heads-up display – at the MIT Museum, in the exhibition Robots and Beyond. The system is intended to "'understand the use' and to produce an output based on the interpretation of the user's intention in context". This, however, is inevitably based on behaviour – time spent in particular places, objects viewed (an advantage of the heads-up system), information requested etc – rather than on the analysis of any learning per se.

The Electronic Guidebook project at the Exploratorium in San Francisco makes effective use of handhelds (Semper and Spasojevic 2002). As with Sparacino's work, many of the lessons learned relate to visitor behaviour and to practical matters. Seen as a highly positive feature, the ability to bookmark material for subsequent retrieval was identified as instrumental in facilitating playing with the exhibits, central to the Exploratorium's philosophy, where "the right answer is a question" (Klages 1995). In contrast, there was a tendency for reduced interaction, both with the exhibits themselves and with other visitors. This negative aspect appeared to have both mechanical and cognitive dimensions: the need to hold the device reduced hands-on activity while the reading demands inhibited conversation.

Hsi (2003) follows up this work with a further study. She concentrates rather more on learning issues, on what she terms "nomadic inquiry". Learners can manipulate information and conduct investigations while moving between the physical exhibit, the virtual realm of the handheld and other experiences. However, while positive about the potential of the system, she again highlights the two major concerns previously identified: the danger of replacing hands-on interaction – "mediated by conversations with others and cognitively challenging" – with "a heads-down one-way transmission of information". Avoiding this requires careful instructional design; learners can then benefit from their mobility within the physical context of objects and exhibits without feeling socially or physically isolated.

within months the majority of those who enter the physical space of a museum will be carrying their own digital communications device

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Combatting social and physical isolation is something towards which museums strive, particularly in relation to visitors with disabilities. The MUSEpad project is designing, developing, and evaluating a mobile computing tool that will enable visitors with disabilities to "customise and optimise their learning and leisure experiences in museums through the emerging technology of WorldBoard" (Kirk 2001). As with other schemes referred to here, WorldBoard utilises wireless connectivity and positioning technologies to extend the capabilities of the web by virtually attaching information and tools to specified locations. As is often the case in the development of learning materials for learners with special educational needs, one's response here is to ask, 'Why only for visitors with disabilities? Should not emerging technologies be used to enable all visitors to optimise their learning?'

Although special attention is paid to learners with disabilities (eg a tour in British Sign Language) The Tate Modern's Multimedia Tour programme also includes two other different types of handheld tours: a Multimedia Highlights Tour and a Collections Tour. All of these relate to other gallery activities and fulfil many educational aims. Quantitative and qualitative evaluation has generated valuable knowledge about visitors' thoughts on handheld tours in museums.

Proctor and Burton (2003) report on the pilot of Tate Modern's handheld scheme. As with the Exploratorium, the Tate uses a location-sensitive wireless network. The wireless network provided information from a central server (rather than being stored in the memory of the handheld device) which meant that practically limitless content could be provided and could easily be kept up-to-date. Location sensitivity meant that 'visitors no longer needed to spend time searching the multimedia tour to find the relevant information for a room, because the network pinpointed their exact location in the gallery and fed the correct information to them at the right time'. The latter advantage proved, however, to also be a disadvantage, in that it was found to 'take attention away from other objects in the gallery which are not on the tour'.

Both video and still images, as well as text, about the works on display were provided for visitors in a variety of different media on a portable screen-based device – a handheld PC. The system offered additional context for the works on display, with experts talking about details of a work, while the details were simultaneously highlighted on the screen. Interactive screens encouraged visitors to respond to the art on view, for instance by answering questions or by layering a collection of sound clips to create their own soundtrack for a work. Some visitors wanted more text; others less. Many found the dynamic presentation valuable; others a distraction. In many ways the material presented in audio format proved to be the best complement to the physical exhibit, acting like a friend. Contrary to some expectations, visitors coped well with the multiple media – object, screen, soundtrack – even when the presentation was not perfectly synchronous. They did not seem to find multi-tasking and multi-tracking of different media (eg switching attention between screen and artwork) to be a problem, as long as the message was well designed and the device was functioning properly. The multimedia tour clearly had the effect of making the visitor look longer at an object than he or she

would have otherwise, even though the screen was also commanding attention. Table 3.1 summarises the positive and negative features identified by the first trial, while further user feedback includes opinions on interactive content such as texting and games, artists' contributions, links between audio and visual, use of film clips, and provision of text-based information (Wilson 2004).

Positive	Negative
strong link between audio and visual	long messages
interactivity, requesting a response	blank screen
audio (including navigation)	text
video	absence of help menu
intuitive interface	

Table 3.1 Positive and negative aspects of the Tate Modern's multimedia tour pilot (after Proctor and Burton 2003)

The project received a BAFTA award for 2002, but has continued to move on. Four key areas were identified for further development and several of these seem likely to have a real impact on the learning potential of the technology:

- direct communication (real time?) with staff
- peer-to-peer communication (already implemented: see Wilson 2004)
- access to online databases while on-site in the gallery
- faster processing and more sophisticated location sensitivity.

3.5 SUMMARY

These examples illustrate some of the reasons why any debate asking objects or interactives? is already significantly out of date. Learning in museums is concerned with objects but also essentially with people. One of the paradoxes of the application of digital technologies is that they can simultaneously provide a personal, individualised experience and yet at the same time offer unprecedented opportunities for the kinds of wider social interaction that can enrich learning. In the 21st century museum, too, questions of real or virtual also have far less meaning even than four or five years ago, as sensitive and appropriate use of technology is seen to enrich the experience of learning from objects and exhibits, rather than competing with them.

learning in museums is concerned with objects but also essentially with people

ONLINE LEARNING

4 ONLINE LEARNING

"Want to find out what the world was like a century ago? Visit a museum. Want to find out what computer-based learning was like a decade ago? Visit a museum website!"

Was this speaker at a recent Museums and the Web conference being cruelly satirical or provocatively inaccurate? Possibly both, for a look at museum websites reveals almost every possibility from the tediously dull and trivial to the imaginative and innovative. This section of the review will describe some of the major web resources currently available, and begin to explore how web resources can reflect underlying theories of learning.

4.1 EVALUATING ONLINE LEARNING

There is little understanding of what makes a successful museum website in terms of learning potential (MDA 2001). There are few formally developed measures for evaluating educational websites in general, let alone museum sites:

"While it is clear that museum resources can have a distinctive contribution to make in terms of the learning that they can generate, it is not clear whether this distinctiveness is appreciable in classroom use of websites or whether there are different expectations and different criteria involved in judging educational web resources generated by museums." (MDA 2001)

In an attempt to provide evaluation criteria, Schaller et al (2002) conducted a study of learners' preferences for different types of web-based educational activities. From a variety of museums' websites they identified six distinct types of activity:

- creative play
- guided tour
- interactive reference
- puzzle/mystery
- role-play/stories
- simulation.

They found significant differences in the preferences of adults and children, which they attribute to differences in motivation. Adults, they contend, "know what they want to learn and they want to learn it in the most direct way". Children, by contrast, "respond positively to the opportunity for interaction and choice within a goal-based environment". The authors assume these differences to be axiomatic and hardly surprising.

Potentially more useful is their analysis of the correspondence of different types of web learning activity with pedagogical approaches: "discovery learning lends itself to puzzles and mysteries, with their single correct solution, while constructivism supports user-created outcomes that allow more personal choice and involvement". Most valuable is their general conclusion that some combination of reference and play is likely to provide maximum appeal and, therefore, most learning potential.

4.2 MUSEUM WEBSITES

Many major museums and galleries carry web-based products that tend towards one or other of these extremes, often reflecting the pedagogical perspectives of their originators – curators, educators or web designers.

The British Library began the Electronic Beowulf project in 1993, as one of a number of initiatives to increase access to its collections by the use of imaging and network technology (www.bl.uk/collections/treasures/beowulf.html). This electronic version of Beowulf provides new, easy-to-use search facilities to help readers explore the texts, opening up the possibilities for sophisticated interpretation and "close to challenging the object in terms of being the ultimate repository of knowledge" (Knell 2003)

The British Museum's major online learning resource is Compass (www.thebritishmuseum.org.uk/compass). This is essentially an annotated online database featuring around 5,000 objects chosen by the curators "to reflect the extraordinary range of the British Museum's collections".

"The system features a wealth of links, background information and maps. There are online tours on a variety of subjects, including introductions to the current exhibitions. Each object featured is illustrated with high quality images that you can enlarge and study in detail. The information has been written with the general visitor in mind, and technical terms are explained in glossary links. If you want to find out more, many of the articles give references to books recommended by the curators."

In contrast, Loverance (2001) summarises the British Museum's development of educational websites on Ancient Civilizations (www.ancientegypt.co.uk and www.mesopotamia.co.uk). She suggests three alternative strategies to draw learners from better known to less well-known areas of content:

- familiarity or skills transfer
- discovery or experimentation
- confounding expectations.

The National Maritime Museum (www.nmm.ac.uk) "seeks to promote online learning as an extension of the Museum's collections" - through activities, resources and information. The material appears fairly typical of museums' online learning offers: a mixture of downloadable resources, fun activities and textbook-type pages. All carefully constructed and well presented, but using digital technologies essentially as a delivery mechanism.

The museum's Search Station (www.nmm.ac.uk/searchstation) is a more sophisticated product, the reception of which has been universally positive (Smith 2000). It offers interactive, computerised access to nearly 2,000 items from the Museum's collections that may not be on display. In the Museum, visitors can access the Search Station using ten linked workstations, always available to adult learners and researchers and bookable by school groups. The materials are also available online on the Museum's website, and as a hybrid CD-Rom for primary schools.

Online exhibitions can offer multiple learning paths through material in ways that real exhibitions cannot. The Smithsonian's Revealing Things (www.si.edu/revealingthings), for example, uses Thinkmap® for the provision of a dynamic interface in which the learner has control over content and narrative. Such features permit a large degree of experimentation, by both learner and expert provider (Freedman 2003).

online exhibitions can offer multiple learning paths through material

ONLINE LEARNING

A focus on the personal meanings and histories of objects is the essential element of a new Culture Online project: Every Object Tells A Story (www.cultureonline.gov.uk/projects/object.asp). Aiming to encourage visitors (both physical and virtual) to create their own stories and to share their interpretations of hundreds of featured objects, the project offers a rich multimedia menu. Very much a two-way process, learners can upload their own perceptions and perspectives – and their own related objects – to the site via PC or mobile phone. Culture Online emphasises that Every Object Tells A Story has specific relevance to the National Curriculum for English. It is a comment on the content constraints of other subject areas that such a rich resource cannot claim anything but a serendipitous link elsewhere.

A second Culture Online project, The Dark (www.cultureonline.gov.uk/projects/dark.asp), also integrates a real museum/gallery experience with an online presence: the website and (touring) installation complement and support each other. Designed to create a 3D soundscape "filled with the virtual ghosts of our past", it is intended to challenge the ways in which information is received and perceived.

The British Art Information Project (BAIP) is being developed as an integral part of the creation of the new Tate Britain, complementing the new gallery spaces. It is creating a fully indexed database of high quality digital images for all 50,000 British works and is "of extraordinary importance for the study and appreciation of British art" –incorporating the paintings, sculptures, works on paper and prints, and including a vast quantity of relatively inaccessible material, such as watercolours and sketchbooks, including the Turner Bequest. It forms the basis for a range of new public information and education services delivered both at the Gallery and through the web. New images without copyright restrictions are already being fed through to the public via the Tate website each day, with new search mechanisms and other content generated by the project (Smith 2000).

The 24 Hour Museum (www.24hourmuseum.org.uk/index.html) is the UK's national virtual museum and acts as a portal to a rich range of resources. It aims to encourage visitors out into real sites by showcasing activities all over the UK, as well as news and exhibition information. Its database includes over 2,800 museums, galleries and heritage attractions and simple but effective search procedures give access to the museums' material, by place, date or subject. Internet trails produced in partnership with museums and galleries provide significant opportunities for learning.

Show Me (www.show.me.uk) is the children's version of the 24 Hour Museum and gives access to 'cool', 'crazy', 'fun', 'scary' and 'wild stuff' from UK museums, some of it developed specially in collaboration with educators and website developers in the museums themselves. (Call it anything but learning, seems to be the message.) The learning opportunities, however, range widely in both subject matter and strategy, as indicated by the examples in Table 4.1. (For a review of the wider context of learning through computer games, see Kirriemuir and McFarlane (2004).)

Fathom (www.fathom.com) is a rather different example of museums'

Title	Invitation
Cabinet of Curiosity	Here's your chance to be a museum curator
Digging Up The Romans	History of Roman London - excellent for homework
Mission: Explore	Fancy being a scientist? Need a mission? This is the game for you
Move It! In 1850 By Train, Wagon And Boat	A Victorian race against time and money
Space Station	Sweat and wee in outer space
The Dig	Medieval? Victorian? Modern? You decide
The Story Of Trim The Cat	A cheeky ship's cat is the star of this tale
Where's Monty?	Lift the leaves to find Monty and his mates

Table 4.1: Examples of web-based museum learning projects on Show.Me (Taken from www.show.me.uk/games/games.html)

involvement in online learning and provides something of a salutary case study. Fathom was intended as a comprehensive directory of related online courses offered by universities and cultural institutions, including four major UK museums. Indeed it successfully offered a wealth of content, including multimedia lectures, articles, interviews, exhibits and seminars, featuring prominent museum curators and researchers. However, it failed for essentially commercial reasons, not because of its approach to learning – although this could be questioned (rather generally linear and reminiscent of a series of textbooks). The site continues to be maintained by Columbia University as an archive of online learning resources.

4.3 WEB STRATEGIES AND LEARNING THEORIES

The Natural History Museum was the first UK museum to establish a web presence and remains one of the most frequently visited of all museum websites. Table 4.2 compares excerpts from the museum's web strategy with key points from its education policy. What follows explores how these attributes manifest themselves in the current set of learning resources both on the NHM site and in the example of the MOLLIS initiative.

ONLINE LEARNING

Electronic exhibitions: NHM policy (The Natural History Museum 2000)	Education policy (www.nhm.ac.uk/education/policy.html)
• approach issues as far as possible from the visitor's perspective – enthusiasm, reticence, prior knowledge, misconceptions et al – • enhance access to the Museum's collections and research, in ways that primarily make sense to the visitor rather than the expert. Virtual visitors can • create their own agendas and their own pathways to learning • create coherent frameworks and signposts, rather than deliver raw data or pre-packaged information.	Important principles underlie all educational activities. These include: • opportunities for differentiation • clear objectives • active learning based on direct observation • asking appropriate and informed questions • emphasis on the processes and methods of science • making links (with previous knowledge and with new ideas) • challenging assumptions and changing perspectives.

Table 4.2: Excerpts from The Natural History Museum's web strategy and education policy

4.3.1 QUEST

QUEST– (Questioning, Understanding and Exploring Simulated Things) (www.nhm.ac.uk/ education/quest2/English/index.html) – began as part of the SIMILE project, supported by funding from the Information Society Project Office of the European Commission. (The principal aim of the SIMILE project – Students In Museum Internet Learning Environments – was to increase learners' access to cultural heritage, as represented by artefacts, objects and specimens in museum collections.)

The Museum's education policy (www.nhm.ac.uk/education/policy.html and see Table 4.2) highlights active learning in terms both of learner participation and of the learner making his or her own sense of experiences. Emphasis is therefore given to observation and enquiry. In this context it would not be tenable simply to display photographic images of objects together with traditional labels. Unlike many exhibitions and much of the educational material in museums, QUEST is deliberately intended to facilitate learner decision-making and user choice. Its approach is essentially constructivist on both of the dimensions identified in Hein's (1995, 1998) analysis of museum learning. QUEST's home page presents twelve objects, familiar and unfamiliar, carefully chosen to be as representative as possible. Selecting any object presents it full-screen, together with a series of icons

giving access to the virtual tools that can be applied to it. Virtual learners can view the object from different angles, measure it, weigh it, magnify it, touch it (for texture and temperature) and even find out its age. More innovative, though, are the 'ask a scientist' page (for further questions or suggestions, rather than answers) and the 'notebook'. When active, the latter enables learners to record their observations, deductions and conjectures – and to share them with others. Only at this stage can a page of information be accessed, written in a discursive style.

So, does it work? Can such an essentially constructivist approach really facilitate learning? A pilot study in schools and online feedback both suggest so. The thousands of users, with an average dwell time of 18 minutes, confirm its attractiveness. But the most compelling evidence comes from an analysis of the comments in the notebook. Most significant is the number of learners who choose to delay accessing the right answer until they have thoroughly explored the object and shared in an online debate. The experience of QUEST does suggest that real learning is possible from virtual objects, and it is active learning predicated on discovery rather than merely passive (Hawkey 1998, 1999, 2000).

4.3.2 Walking with Woodlice

There is a tendency to assume that the use of web-based learning material is somehow an alternative to real learning. One of the features of Walking with Woodlice (www.nhm.ac.uk/woodlice) is that it promotes learning not only in the real (but artificial) world of the classroom or teaching laboratory but also in the real (and natural) world of the environment beyond. The promotion of fieldwork and its interaction with digital technologies – through data recording and analysis – is a key element of the project. And, although the museum can call upon the leading experts in the field, it is less concerned with approving and validating the findings than with encouraging participants, having submitted their own data, to join in analysing and commenting on the results. (Hawkey 2002)

4.3.4 MOLLIS (www.molli.org.uk)

Museum Open OnLine Learning Initiatives (MOLLIS) have been developed in a partnership between the University of Exeter and local museums (Dillon and Prosser 2003). Learning activities are analysed as a series of dynamic processes; each is a discrete educational entity, but every individual's experience arises from a unique and complex combination of them all:

- information exchange – facts and constructs that can potentially be integrated into a context
- skills application – ability to perform actions
- knowledge construction – integrating new information with previous learning
- social interaction – reciprocal action in exchanging or challenging ideas
- self-expression including beliefs and creativity.

Collectively, these processes amount to the construction of meaning in the gap between the object and the individual. The web-based learning community is a weak

real learning is possible from virtual objects

THE FUTURE: MORE OF THE SAME... OR SOMETHING COMPLETELY DIFFERENT?

system, characterised by differentiation and change. Better understanding will require synthesis and integration of what is known about the nature of information, the characteristics of complex communities and instructional design for online learning.

4.4 WEBCASTS

Webcasts are a developing feature of the e-learning offer of an increasing number of museums. Initially seen as a way of introducing the human dimension – of curator, researcher, expert – at far less cost than film or TV, they provide another example of synergy. Webcasts give the learner the potential for interaction not (yet) otherwise available. Participants can ask questions, feedback ideas or preferences and engage in a raft of other activities. A pioneer in the museum realm, the Exploratorium offers a programme of frequent live webcasts while the Natural History Museum – from its Darwin Centre – has an equally ambitious commitment to creating an ever-increasing archive of its daily Darwin Centre Live programme. In both cases video and audio is streamed over the internet, although different platforms are utilised. (A recent highlight was a three-way collaboration between the two institutions and the NHM's field research station in Belize (www.exploratorium.edu/origins/belize-london/index.html).)

webcasts give the learner the potential for interaction not (yet) otherwise available

In many ways such webcasts are a natural development of the kinds of public presentations given on-site, themselves extensively supported by a range of digital technologies. Presentation is a more apt term than talk or lecture, although encounter or exchange might place further emphasis on the aspiration of two-way communications, especially in science museums, where dialogue is replacing deficit as a model: see also, for example, the Dana Centre at the Science Museum (www.danacentre.org.uk) or the Boston Museum of Science (www.mos.org).

4.5 SUMMARY

Museum websites may have begun as digital brochures and developed subsequently into online representations of the physical museum, but they have not stopped there. Generally resisting the temptation to use the latest special effects for their own sake, they show considerable diversity – of content, design, philosophy and navigational practice. The best are among the best sites for learning anywhere on the internet. While not professing to play the same kind of role as commercially produced games, many museum websites provide enjoyable and meaningful experiences in which the representation of objects and artefacts and the motivation and active engagement of learners are clearly paramount.

5 THE FUTURE: MORE OF THE SAME... OR SOMETHING COMPLETELY DIFFERENT?

To what extent will museums continue to use digital technologies to facilitate the same kinds of learning as earlier, more traditional approaches? Will cultural institutions inevitably become hybrids of the real and the digital? How far can they go in using new opportunities to foster completely new strategies? What kinds of learning philosophy and rationale – explicit

or implicit – are discernable? What are the key parameters that museums need to address when planning future opportunities for learning with digital technologies? Where do the tensions lie? What are the risks in making the wrong decisions – or in making no decisions at all beyond the maintenance of the status quo?

Museums began to develop electronic exhibitions and learning resources for a number of reasons. They were able to showcase a wider range of objects; they could mount exhibitions on different – and difficult – subjects, perhaps more specialised or more topical; they could increase outreach and access; they could attract more visitors to the physical museum. These aims have already been realised. They have certainly moved well beyond the use of ICT to facilitate the school visit or field trip (Schmidt 1997; Tinker et al 2002). Beginning to emerge are signs of a revolution far greater than that envisaged in A Netful of Jewels (National Museum Directors' Conference 1999) or in Building the Digital Museum (Smith 2000).

Since the proliferation of museums in the late 19th century there have been many changes (Table 5.1). The museum's relationship with its visitors, with potential learners, has moved from (in)tolerance through encouragement (in search of visitor numbers) to empowerment (as philosophies alter). Once the only raison d'être, objects – while no longer quite as exotic – retain (or, possibly, have regained) their uniqueness. The most dramatic change lies with digital technologies, initially feared as competitor, now welcomed as ally.

	1880s	1990s	2020?
Objects	exotic	marginal	essential
Learners	tolerated	encouraged	empowered
ICT	n/a	alternative	integral

Table 5.1 2020 vision (Hawkey 2001)

So, whither learning in the 21st century museum? Abungu (1999) is clear that, "Museums of the 21st century are places to explore, and to learn through discovery. The exhibits should not provide all the answers, but be interactive and stimulate the visitor to ask questions."

Sheppard (2001) agrees with the significance, in terms both of discovery and of intellectual development: "Museums encourage discovery. Through the power of objects, they help visitors link their worlds to those of other times and places. Through both content and context, museums teach visual thinking skills, using tangible objects to help visitors understand and respect the diversity of their worlds."

It has been convenient in this review to deal separately with learning on-site, in the physical space of the museum, and online – at home, school or wherever. However, as with the distinction between formal and informal learning, the boundaries are blurring (Fig 5.1) and it would be a mistake to make any assumptions based on the traditional

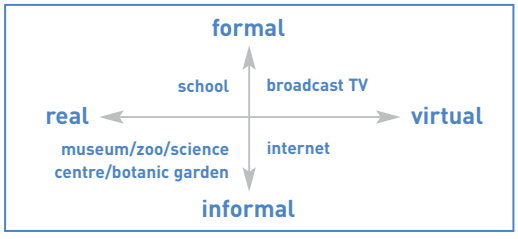

Figure 5.1 Persistent dichotomies or blurring the boundaries? (Hawkey 2001b)

THE FUTURE: MORE OF THE SAME... OR SOMETHING COMPLETELY DIFFERENT?

for the future the need is for an entirely fresh approach

paradigms either of museums or of e-learning. It is certainly not sensible to think that the future of learning with digital technologies in museums and galleries lies merely with some hybrid synthesis of the educational expertise of the classroom teacher with the functionality of any extant museum website.

Museums may be educational innovators, but virtual museums have evolved primarily as replications of the physical structure of museums rather than being based on their underlying and originating principles (Goldman and Kaplan 2002). Indeed, "many museums are failing themselves and their users by creating a digital pastiche of the physical museum, rather than seizing the opportunity to extend and enhance the museum learning experience offered by effective use of ICT" (Prosser and Eddisford 2004). Mitchell (2002) suggests treating time and space as the key variables (Table 5.2): are the visitor and the interpreter in the same place at the same time? This analysis has interesting implications, for the key difference between a real exhibition and a virtual exhibition is the location of the visitor, as the interpreter is not present simultaneously in either case. This approach also has the advantage of removing the real or virtual dilemma. It helps us to recognise that 21st century technologies enable digital materials to supplement and enhance 3D objects.

	local	remote
synchronous	live tour / personal interaction	live webcast
asynchronous	physical exhibit, with interpretation in 'stored' medium	online exhibit

Table 5.2 Exhibits, interpretation, media (after Mitchell 2002)

For the future the need is for an entirely fresh approach. Current mutations may give rise to the rapid evolution of totally new species that incorporate radically new ways of thinking – about museums, about learning and about digital technologies:

- individual exhibits (or components) rather than exhibitions
- learner input in development
- pathways rather than packages
- signposts rather than tracks
- new concepts of temporality and permanence.

The integration of real and virtual will provide further powerful learning opportunities. Jones (2002) develops some of the feedback features of mobile interpretative methods into the notion of the self-learning hypermuseum. Here, the tracking of visitors and the analysis of their behaviour patterns is used not only generically in helping to evaluate both exhibits and interpretative materials, but also to develop a differentiated and individualised approach. The combination of both real and virtual objects with artificial intelligence systems enables the museum itself to learn, to adapt to new visitors, based on the patterns, preferences and predilections of previous visitors.

Knell (2003) argues that the object will inevitably remain the ultimate repository of knowledge, even if technologies do provide possibilities for sophisticated interpretation. Museums may wish to present their audiences with challenges, but they will still want control of the thrust

of the interpretation. Yet, as Freedman (2003) asserts, individual objects have shifting and ambiguous meanings; their significance is open to multiple interpretations and highly dependent upon context. Key to an individual learner's understanding is the opportunity to construct a large number of meaningful conceptual connections. In a physical exhibition this possibility is restricted to the selection of the curator/designer; with an online exhibit learners are able to construct their own personalised narratives.

Personalisation is the way forward. Not the kind of personalisation represented by the supermarket loyalty card or the website cookie. But personalisation of interpretation, of technology and of learning. Personalisation of interpretation could significantly enhance social and intellectual inclusion. Personalisation of technology could free both museums and learners from many of the current constraints. Personalisation of learning could finally facilitate an escape from the deficit models so prevalent in educational institutions and release untold potential.

"Let's do the interesting bits first, then we might not have time for the boring bits!" Said by a child to the adults accompanying her on entering a major national museum, this highlights the need for personalisation. Just as no two museums are identical, not even two exhibitions within a museum, so all museum visitors, all learners, are different. Prior to the introduction of digital technologies it was possible to distinguish only between museums that presented a single curatorial view and those – with the visitor in mind – that assumed all visitors to be well-educated good readers of English. Trying to layer content on text panels, using different fonts or point sizes, had serious implications for learning and for design integrity.

Imagine a family group of two adults, with different subject interests and preferred learning styles, and two or three children, of various ages, abilities and attention spans. With personalised applications of digital technologies, they can all share the same experience – look at the same artefact, engage with the same activity – but each can fine tune it in ways of his/her own choosing. This might mean a different language, presentation style, degree of complexity, technical vocabulary etc. It might mean a choice of very different approaches to the same material: information or inquiry, instruction or investigation. Every exhibit has numerous logical links to other exhibits, which may be physically separated or only available digitally. Whether on-site or online (or both) these links can be made real for each individual. The group has a shared experience, enhanced by their own choices, which can then in turn be shared with each other.

The story of digital technologies in educational contexts has often been one of a solution in search of a problem. The provision of learning opportunities in museums has frequently been driven by the agendas of expert curators or of the formal education sector. Drawing on the example provided by Inspiring Learning for All (MLA 2004) it is time for educators to take the lead and to make demands of both museums and technologists. For, after all, learning in museums with digital technologies is principally about learning.

it is time for educators to take the lead and to make demands of both museums and technologists

BIBLIOGRAPHY

24 Hour Museum (2003). 2002 Sector Web Statistic Comparisons. Brighton: 24 Hour Museum. www.24hourmuseum.org.uk

Abungu, G (1999). Message from the Director-General, National Museums of Kenya. www.museums.or.ke/dg.html

Anderson, D (1999). A Common Wealth: Museums in the Learning Age. London: Department of Culture, Media & Sport

Arnold, K (1996). Presenting science as product or process: museums and the making of science, in: S Pearce (Ed), Exploring Science in Museums. London: Athlone Press

Bazley, M (1998). The internet: who needs it? Journal for Education in Museums, 19, 40-43

Boon, T (2000). The opportunities of hybridity: making the modern world, a new historical gallery in a diverse institution. Paper presented at Science Communication, Education, and the History of Science, British Society for the History of Science, London, 12-13 July

Bradburne, J (2001). A new strategic approach to the museum and its relationship to society. Museum Management and Curatorship, 19(1), 75-84

Cameron, F (2001). Wired collections – the next generation. Museum Management and Curatorship, 19(3), 309-312

Caulton, T (1998). Hands-on Exhibitions. London: Routledge

CLMG (Campaign for Learning in Museums & Galleries) (2002). www.campaignforlearning.org.uk

DfEE (Department for Education and Employment)/QCA (Qualifications and Curriculum Authority) (2000). Information and Communication Technology: the National Curriculum for England Key Stages 1-4. London: The Stationery Office. www.nc.uk.net/index.html

DigiCULT Consortium (2003). Learning Objects from Cultural and Scientific Heritage Resources. Salzburg: DigiCULT Consortium. www.digicult.info

Dillon, P and Prosser, D (2003). Educational transactions in museum online learning Initiatives. International Journal on E-Learning, 2(1), 14-20. http://dl.aace.org/11549

Durbin, G (2002). Interactive learning in the British galleries, 1500–1900. Paper presented at Interactive Learning in Museums of Art and Design. London, 17–18 May. www.vam.ac.uk/exploring/cons_research/interactive_learning

Durbin, G (2004). Learning from Amazon and eBay: user-generated material for museum web sites, in: Bearman, D and Trant, J (Eds) Museums and the Web 2004: Proceedings. Toronto: Archives & Museum Informatics. www.archimuse.com/mw2004/papers/durbin/durbin.html

Elinich, K (2004). The key to science inquiry: Keystone Online. Society for Information Technology and Teacher Education International Conference 2004, 4637-4642. http://dl.aace.org/15197

European Commission (2002). Technological Landscapes for Tomorrow's Cultural Economy: Unlocking the Value of Cultural Heritage. DigiCULT report. Luxembourg: Official Publications of European Communities. www.digicult.info/pages/report.php

Falk, J and Dierking, L (2000). Learning from Museums: Visitor Experiences and the Making of Meaning. Walnut Creek, CA: AltaMira Press

Falk, J and Dierking, L (2002). Lessons Without Limit: How Free-Choice Learning is Transforming Education. Walnut Creek, CA: AltaMira Press

Freedman, M (2003). Think different: combining online exhibitions and offline components to gain new understandings of museum permanent collections, in: D Bearman and J Trant (Eds), Museums and the Web 2003: Selected Papers from an International Conference. Toronto: Archives & Museums Informatics. www.archimuse.com/mw2003/papers/freedman/freedman.html

Galani, A and Chalmers, M (2002). Can you see me? Exploring co-visiting between physical and virtual visitors, in: D Bearman and J Trant (Eds), Museums and the Web 2002: Selected Papers from an International Conference. Pittsburgh, PA: Archives & Museums Informatics. www.archimuse.com/mw2002/papers/galani/galani.html

Gammon, B (2001). Assessing Learning in Museum Environments: a Practical Guide for Museums Evaluators. London: Science Museum

Gardner, H (1991). The Unschooled Mind: How Children Think and how Schools Should Teach. New York: Basic Books

Gardner, H (2004). What we Do and Don't Know About Learning. Dædalus, 133(1), 5-12

Geser, G (2003). Introduction and overview, in: DigiCULT Consortium, Learning Objects from Cultural and Scientific Heritage Resources. Salzburg: DigiCULT Consortium. www.digicult.info

Gilbert, JK and Stocklmayer, S (2001). The design of interactive exhibits to promote the making of meaning. Museum Management and Curatorship, 19(1), 41-50

Giorgini, F and Cardinali, F (2003). From cultural learning objects to virtual learning environments for cultural heritage education: the importance of using standards, in: DigiCULT Consortium, Learning Objects from Cultural and Scientific Heritage Resources. Salzburg: DigiCULT Consortium. www.digicult.info

Goldman, M and Kaplan, D (2002). Museum education in an age of wireless communication. World Conference on Educational Multimedia, Hypermedia and Telecommunications 2002, 688-689. http://dl.aace.org/10188

Gregory, R (1989). Turning minds on to science by hands-on exploration: the nature and potential of the hands-on medium, in: Nuffield Foundation, Sharing Science: Issues in the Development of the Interactive Science and Technology Centres. London: British Association

Hall, J (2004). Telling Old Stories New Ways: Using Technology to Create Interactive Learning Experiences. Washington: Smithsonian Center for Education and Museum Studies. http://museumstudies.si.edu/hall.pdf

Hawkey, R (1998). Exploring and investigating with the internet: virtually as good as the real thing? Journal for Education in Museums, 19, 16-19

Hawkey, R (1999). Learning from objects on-line: virtue and reality. British Journal of Educational Technology, 30(1), 73-77

Hawkey, R (2000). Real education from virtual objects: active learning in science on-line, in: R Robson (Ed), Proceedings of M/SET 2000. Charlottesville, VA: Association for the Advancement of Computing in Education

Hawkey, R (2001a). Innovation, inspiration, interpretation: museums, science and learning. Ways of Knowing Journal, 1(1), 23-31

BIBLIOGRAPHY

Hawkey, R (2001b). Science beyond school: representation or re-presentation?, in: A Loveless and V Ellis (Eds), ICT, Pedagogy and the Curriculum: Subject to Change. London: Routledge/Falmer

Hawkey, R (2002a). The lifelong learning game: season ticket or free transfer? Computers & Education, 38(1-3), 5-20

Hawkey, R (2002b). Walking with woodlice: biodiversity on-line and in the field, in: D Watson and J Andersen (Eds), Networking the Learner: Computers in Education. Boston, MA: Kluwer Academic Publishers

Heath, C and vom Lehn, D (2002). Misconstruing interactivity. Paper presented at Interactive Learning in Museums of Art and Design. London,17–18 May. www.vam.ac.uk/exploring/cons_research/interactive_learning

Hein, G (1995). The constructivist museum. Journal for Education in Museums, 16, 21-23

Hein, G (1998). Learning in the Museum. London: Routledge

Hein, H (1990). The Exploratorium: The Museum as Laboratory. Washington, DC: Smithsonian Institution Press

Hemmings, T, Clarke, K, Francis, D, Marr, L and Randall, D (2001). Situated knowledge and virtual education: some real problems with the concept of learning and interactive technology, in: I Hutchby and J Moran-Ellis (Eds), Children, Technology and Culture: The Impacts of Technologies on Children's Everyday Lives. London: Routledge/Falmer

Hepple, S (2000). How might elLearning really change educational policy and practice?, in: Johnson, M (Ed), Education Futures. London: Design Council/RSA

Hepple, S (2001). Preface, in: A Loveless and V Ellis (Eds), ICT, Pedagogy and the Curriculum: Subject to Change. London: Routledge/Falmer

Hinton, M (1999). The Victoria and Albert Museum Silver Galleries II: learning style and interpretation preference in the Discovery Area. Museum Management and Curatorship, 17(3), 253-294

Hooper-Greenhill, E, Dodd, J, Moussouri, T, Jones, C, Pickford, C, Herman, C, Morrison, M, Vincent, J and Toon, R (2003). Measuring the outcomes and impact of learning in museums, archives and libraries. End of project paper for the Learning Impact Research Project. Leicester: Research Centre for Museums and Galleries. www.mla.gov.uk/action/learnacc/00insplearn.asp

Hsi, S (2003). A study of user experiences mediated by nomadic web content in a museum. Journal of Computer Assisted Learning, 19 (3), 308-319

Johnson, C and Quin, M (2004). Learning in science and discovery centres - appendix, in: Science Center Impact Study. Washington, DC: ASTC, in press

Jones, S (2002). The HyperMuseum. Paper presented at the 3rd Science Centre World Congress, Canberra, Australia, February

Kirk, J (2001). Accessibility and new technology in the museum, in: D Bearman and J Trant (Eds), Museums and the Web 2001: Selected Papers from an International Conference. Pittsburgh, PA: Archives & Museums Informatics. www.archimuse.com/mw2001/papers/kirk/kirk.html

Kirriemuir, J and McFarlane, A (2004). Literature Review in Games and Learning. Bristol: Futurelab

Klages, E (1995). When the Right Answer is a Question: Students as Explainers at the Exploratorium. San Francisco, CA: Exploratorium

Knell, S (2003). The shape of things to come: museums in the technological landscape. Museum and Society, 1(3), 132-146

Littlejohn, A and Higgison, C (2003). A Guide for Teachers (e-Learning Series No 3). York: Learning and Teaching Support Network (LTSN)

Loverance, R (2001). Playing on familiarity: online learning at KS2 from Egypt to Mesopotamia. Paper presented at CAL2001, University of Warwick, April 2-4

mda (2001). Building Digital Content: a Study in the Selection, Presentation and Use of Museum Web Content for Schools. London: mda. www.mda.org.uk/bdc_conc.htm

Miles, RS, Alt, MB, Gosling, DC, Lewis, BN and Tout, AF (1982). The Design of Educational Exhibits. London: George, Allen & Unwin

Miller, K and Clay, J (1999). Halted by customs: the potential for border crossing with/in developing 'scientific literacy'. Paper presented at British Educational Research Association conference, University of Sussex, September

Mitchell, W (2002). The museum: a building type in transition. Paper presented at Museums and the Web, Boston, April

MLA (Museums, Libraries and Archives Council) (2004). Inspiring Learning For All. London: MLA. www.inspiringlearningforall.gov.uk/utilities/references/default.aspx

Moussouri T (2000). Research Digest. Leicester: Research Centre for Museums and Galleries. www.centresforcuriosity.org.uk/pages/content/index.asp

Moussouri T (2002). A Context for the Development of Learning Outcomes in Museums, Archives and Libraries. London: Resource/Leicester: Research Centre for Museums and Galleries. www.mla.gov.uk/action/learnacc/lirp.asp

National Museum Directors' Conference (1999). A Netful of Jewels: New Museums in the Learning Age. London: National Museum Directors' Conference

NFO System Three (2003). Young People and ICT 2002. Coventry: British Educational Communications and Technology Agency (Becta). www.becta.org.uk

Perry, DL (2002). Profound learning: stories from museums. Educational Technology, 42(2), 21-25

Proctor, N and Burton, J (2003). Multimedia tour pilots 2002-2003. Proceedings of the mLearn Conference, London, May 19-20. www.tate.org.uk/modern/multimediatour/phase1_keyfindings.pdf

Proctor, N and Tellis, C (2003). The state of the art in museum handhelds in 2003, in: D Bearman and J Trant (Eds), Museums and the Web 2003: Selected Papers from an International Conference. Toronto: Archives & Museums Informatics

Prosser, D and Eddisford, S (2004). Virtual museum learning, in: G Marks (Ed), Information Technology in Childhood Education Annual. Norfolk, VA: Association for the Advancement of Computers in Education, in press

Resnick, M (2002). Rethinking learning in the digital age, in: G Kirkman (Ed), The Global Information Technology Report: Readiness for the Networked World. New York: Oxford University Press. http://llk.media.mit.edu/papers/archive/papers/mres-wef.pdf

Resource, The Council for Museums, Archives and Libraries (2001). Museum Learning On Line. London: Resource. www.resource.gov.uk/action/learnacc/muslearn/start.asp

BIBLIOGRAPHY

Schaller, DT, Allison-Bunnell, S and Chambers, MB (2002). How do you like to learn? Comparing user preferences and visit length of educational web sites, in: D Bearman and J Trant (Eds), Museums and the Web 2002: Selected Papers from an International Conference. Pittsburgh, PA: Archives & Museums Informatics. www.archimuse.com/mw2002/papers/schaller/schaller.html

Schmidt, E (1997). Learning from electronic field trips. Journal of Museum Education, 22(1), 10-11

Science Museum (2003). Requirements for all Science Museum Computer Exhibits. London: Science Museum. www.sciencemuseum.org.uk/documentation

Sefton-Green, J (2004). Literature Review in Informal Learning with Technology Outside School. Bristol: Futurelab

Semper, R and Spasojevic, M (2002). Devices and a wireless web-based network to extend the museum experience, in: D Bearman and J Trant (Eds), Museums and the Web 2002: Selected Papers from an International Conference. Pittsburgh, PA: Archives & Museums Informatics. www.archimuse.com/mw2002/papers/semper/semper.html

Serrell, B (1996). Exhibit Labels: an Interpretive Approach. Walnut Creek, CA: Altamira Press

Sharples, M (2000). The design of personal mobile technologies for lifelong learning. Computers & Education, 34, 177-193

Sharples, M (2003). Disruptive devices: mobile technology for conversational learning. International Journal of Continuing Engineering Education and Lifelong Learning, 12, 5/6, 504-520

Shaw, M (Ed) (1995). Highways for Learning: an Introduction to the Internet for Schools and Colleges. Coventry: National Council for Educational Technology

Sheppard, B (2001). Museums, Libraries and the 21st Century Learner. Washington, DC: Institute of Museum and Library Services. www.imls.gov/whatsnew/21cl/21clintro.htm

Smith, L (Ed) (2000). Building the Digital Museum: a National Resource for the Learning Age. London: mda

Sparacino, F (2002). The museum wearable: real-time sensor-driven understanding of visitors' interests for personalized visually-augmented museum experiences, in: D Bearman and J Trant (Eds), Museums and the Web 2002: Selected Papers from an International Conference. Pittsburgh, PA: Archives & Museums Informatics. www.archimuse.com/mw2002/papers/sparacino/sparacino.html

Tawney, DA (1979). CAL and learning, in: DA Tawney (Ed), Learning Through Computers. London: Macmillan

The Natural History Museum (2000). Web Strategy. London: The Natural History Museum

Tinker, B, Staudt, C and Walton, D (2002).The handheld computer as field guide. @Concord, 6(1), 10. http://concord.org/newsletter/2002winter/monday_lesson.html

Wilson, G (2004). Multimedia tour programme at Tate Modern, in: D Bearman and J Trant (Eds), Museums and the Web 2004: Proceedings. Toronto: Archives & Museum Informatics. www.archimuse.com/mw2004/papers/wilson/wilson.html

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Working in partnership with industry, policy and practice, Futurelab:

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- offers hard evidence and practical advice to support the design and use of innovative learning tools
- communicates the latest thinking and practice in educational ICT
- provides the space for experimentation and the exchange of ideas between the creative, technology and education sectors.

A not-for-profit organisation, Futurelab is committed to sharing the lessons learnt from our research and development in order to inform positive change to educational policy and practice.

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