



The Evaluation of Museum Multimedia Applications: Lessons from Research

MARIA ECONOMOU

Introduction

In museums and exhibitions, the use of interactive multimedia applications continues to spread, and now that the technological problems of the early experimental years have largely been solved, curators and educators are focusing more on the audience's needs and the quality of the interactive experience (Bearman, 1995). Although the museum community is becoming increasingly aware of the need to evaluate multimedia displays (McNamara, 1986; Raphling, 1994; Dierking and Falk, 1998), it is surprising and disappointing that to date very few systematic, in-depth evaluation studies are publicly available. This paper first describes briefly the results obtained from a research study which examined the effectiveness of a multimedia application created for exhibition interpretation; and then, it examines the lessons to be learned from this project and refers to their wider implications for those involved in the design and evaluation of museum multimedia. The study was part of doctoral research carried out at the University of Oxford, funded by a scholarship from the Lambrakis Research Foundation, Athens. It focused on the design and evaluation of a prototype gallery interactive developed for the presentation of an important archaeological site, the classical Greek colony of Euesperides in North Africa. This was a component of the temporary exhibition on the archaeology of Euesperides which was organized by the Ashmolean Museum, Oxford, and shown at the Museum of Oxford in autumn 1995. The Euesperides program combined the fragmented information derived from the excavation of the site—near modern Benghazi in Libya (Vickers *et al.*, 1994)—with the historical background of the city (Economou, 1993), and set out to interpret the objects on display.

The project followed all the standard stages of a multimedia production for a museum exhibition: (a) Research on the content of the application; (b) Collection of the material; (c) Multimedia design and programming (Economou, 1995); (d) Formative evaluation; (e) Integration in a museum exhibition; (f) Summative evaluation of the program's effectiveness (Economou, 1996, 1997); (g) Study of the long-term effect on visitors; and (h) Impact on museum staff. More specifically, the areas investigated were:

1. the potential of multimedia for presenting the results from an excavation and thus improving the public understanding of archaeology;
2. the way formative evaluation assisted and influenced the design of the application;

3. who used the program in the exhibition (and who did not);
4. the way those visitors used the multimedia application;
5. the learning outcomes and emotional impact of the program (immediate and long-term); and
6. the effect of the presence of the computer program on the way visitors explored the exhibition.

Methodology

Throughout its design, the Euesperides prototype was tested with a variety of users including schoolchildren, adults, the Education Guides of the Ashmolean Museum, graduate students, and curators. Formative evaluation followed two main approaches: (i) informal sessions observing the users' interaction with the prototype and recording their reactions and comments while they were encouraged to 'think aloud'; and (ii) more structured evaluation, where the users were asked to fill in a questionnaire after using the program. Summative evaluation constituted the main focus of the study and employed six different methods: observation (sample 117) and interviews with users (sample 75) and non-users (sample 59) of the multimedia program, computer interaction logging (361 valid logs of total of 446), self-administered questionnaires (qualitative information, self-selected sample), analysis of comments in the visitors book (qualitative information, self-selected sample), mail survey with computer users five to six months after their visit to the exhibition (38 letters received), and interviews with museum staff. The combination of a variety of methods allowed the comparison of findings and the examination of different aspects of the museum interactive experience (Economou, 1997).

Findings

Overall, the results obtained from the evaluation of the Euesperides prototype were positive about the use of the program both as an independent interpretative device and as a component of the exhibition. However, any generalization must be treated with caution. Like all cultural multimedia products, the Euesperides program was created and used within a unique environment and the results of the study must be considered in this context. Nevertheless, some of the findings have broader applicability and the valuable lessons learned from the Euesperides study would benefit any museum professional considering the use of multimedia technology for public presentation.

Formative Evaluation

The experience from the Euesperides project demonstrated the valuable role of formative evaluation and confirmed the importance of testing with the users. Even when informal and with a small sample, formative evaluation offered useful feedback about the program's content, language, navigation, and the intuitiveness of the interface, before too much effort and resources had been expended. User input throughout the design process led to several changes (for example, in the basic structure of the prototype, the titling of certain features,

and the addition of sound buttons for the pronunciation of difficult words). It also helped to define the profile and needs of different user groups.

The Computer Program as an Interpretative Device

The computer program functioned successfully as a presentation and interpretation medium. It offered background information about the largely unknown ancient city of Euesperides, contextualized the artefacts on display, and explained their importance today. One of the most attractive features of the program was its interactive character. Several users commented on the fact that they could choose what they wanted to see, explore different paths, and control navigation. This was an interesting finding, particularly since in this experimental and low-cost prototype the level of interactivity was actually rather limited. In the event, the computer program turned out to be one of the most popular exhibits in the gallery, receiving the highest number of visitors (40 per cent of the 117 tracked visitors) and the highest number of repeat visits of all exhibits (eight of 32 repeat visits). Additionally, visitors spent more time with the computer program (3.75 minutes mean) than with any other exhibit (1.3 minutes with exhibit in the second ranking). The novelty of the technology appears to have played an important part in this, attracting visitors with no prior knowledge of or interest in the subject. It is likely that this element will become less important in attracting visitors to specific museum displays as the use of computers continues to penetrate all aspects of our lives (Department of Trade and Industry, 1997). The success of the computer program might also be related to the fact that some of the other exhibits were supported by limited or unattractive explanatory material, whereas the objects certainly required some explanation if their meaning was to be understood and the exhibition layout may have been confusing to some.

Several months after their visit, most respondents to the mail survey were able to recall many details of their experience. Visitors remembered not only what they had done and felt during their visit, but could also describe what the exhibition and the program had been about, what they had contained, and the thoughts that these had triggered. Their answers suggest that the visit to the exhibition, and particularly the interaction with the computer program, was memorable and had had a lasting impact. Nevertheless, it was interesting to observe that almost 20 per cent of users interviewed could not describe correctly what the program was about even after three minutes' interaction. In order to understand the subject and main ideas of the program, users apparently needed to invest more than a few minutes. This was particularly true for casual visitors who had come upon the exhibition unprepared and without any particular interest in the subject matter. The results might be related to the complexity and design of the program. It is also possible that for a portion of the audience, the *process* of using a touchscreen computer was the prime attraction during the initial period of interaction, while attention to the subject matter and understanding of it began to be established only after a few minutes' use.

All these findings indicate that in the setting of an exhibition the multimedia program is a very powerful medium with considerable potential for communicating ideas. But they also raise issues about its relationship with the other, more traditional media used in the exhibition, and in particular with the real artefacts.

How did the virtual affect the real, especially in this situation, where they were placed in the same room? This important issue is discussed below.

The Computer Program as a Component of the Exhibition

In direct contrast to the fears of many museum professionals, the results of the Euesperides study indicated that the computer's presence in the exhibition generally enhanced the visitors' experience. For a large section of users the computer interactive contributed considerably to their enjoyment (73 per cent of 75 users interviewed) and understanding of the display (57 to 62 per cent of users interviewed). Similar comments were mentioned in the post-exhibition mail survey. A female visitor in her forties, for example, wrote:

The program provided a useful tool which enabled not only myself, but also my six-year-old son, to gain much more from the exhibition than would otherwise have been the case.... We...felt that being able to use the computer greatly increased our enjoyment and understanding.

Several users mentioned in the interviews that the program made things clearer, put them into perspective, and motivated them to go back and look at the objects again, though over a quarter of the tracked visitors were simply using the exhibition space as a corridor on their way out and a slightly smaller group (19 per cent) would have probably used the exhibition in the same way, but stopped instead to sample the interactive program. As a couple of visitors mentioned specifically in their letters, the computer program was what had attracted them to the display and without which they would probably not have stopped to look at the exhibition at all. Almost half of this group then stayed longer to look at the objects on display, but only after using the program.

Visitors invested substantial amounts of time interacting with the computer, more than with any other individual exhibit, though it was interesting to observe that the time visitors spent at the computer, did not affect adversely the time they spent in the rest of the gallery. Computer users spent over seven minutes longer in the gallery than non-users. Even when the time at the computer is deducted, the remaining time they spent in the gallery (4.8 minutes mean, 2.1 minutes median time) is still considerably higher than the time spent by non-users (Table 1). This confirms that the computer program encouraged visitors to explore and engage with the rest of the exhibits. Furthermore, interaction with the computer program helped several users learn about specific themes related to the exhibition. That learning was related to the acquisition of factual information, but it also involved the consolidation of previous knowledge, the raising of questions, and the development of an awareness of the way in which

Table 1. Comparison of time spent in the gallery between computer users and non-users (sample: 117)

	Mean time with computer	Mean time—rest of exhibition
1. Computer Users	3.7 minutes	4.8 minutes
2. Non-users	-	1.5 minutes

archaeologists work and the types of evidence they exploit to extract information about the past.

At the same time, the program sometimes also overshadowed, at least temporarily, the rest of the displays. Several visitors were absorbed in the Euesperides prototype *while* using it, but some of them would explore the exhibition *afterwards*. Few visitors (eight of 117 observed), however, returned to the computer kiosk after looking at the objects. This indicates that the program was not successful in making direct links with the specific objects on display. One reason for this can be attributed to the late preparation of the exhibition's layout and choice of specific objects to be displayed, which in turn did not allow for the design of more explicit links between the information presented on-screen and the exhibition cases. But even without this practical limitation, the absorbing power of the computer screen made difficult the successful integration of the interactive program with the surrounding static displays.

Who Used the Program?

The specific profile of users and non-users of the Euesperides program might be related to a number of factors, such as the type of exhibition, the specific museum, or its admission policy. What is of general interest is that the computer program appealed to all age and gender combinations. Female and male visitors were equally likely to use it, even when the ratio of male/female visitors is taken into account. This is in contrast to the findings of most museum multimedia evaluations. With the exception of two other studies (Hilke *et al.*, 1988; Allison and Gwaltney, 1991), most evaluations of computer interactives in museum settings showed a predominance of male users (Sharpe, 1983; Doering *et al.*, 1989; Menninger, 1991; McManus, 1993; Giusti, 1994a, b). Furthermore, female users of the Euesperides program tended to spend longer with the program. Children under age 11 represent the largest age group of computer users, almost a quarter of the total number of users (394 valid interaction logs). This confirms the commonly held belief that these programs are popular with a young audience. However, the program was also used by visitors over 55 years old (19 per cent). Unlike most similar studies (Sharpe, 1983; Doering *et al.*, 1989; Allison and Gwaltney, 1991; Giusti, 1994a), more than half of computer users were over 25 (Figure 1).

Both of the results relating to the gender and the age of computer users are not surprising, if we consider the penetration of information technology into all sections of society. It is useful to take into account the results of a study of 5000 households and 1300 businesses in the United Kingdom, the United States of America, Japan, Germany, and France commissioned by the United Kingdom Department of Trade and Industry in 1997. This showed that "across all the benchmark countries ownership and usage of information and communication technologies is growing" (Department of Trade and Industry, 1997, p. 127). Currently the consumer penetration of hardware and infrastructure (39 per cent) is substantially lower than that of business (94 per cent) (Department of Trade and Industry, 1997, p. 17). The expansion of information technology in the business sector is, however, likely to have a growing impact on the general population. From those who use computers outside the home, 33 per cent of their time at either work, school, or college is taken up in front of a computer



1. Family group using the computer program in the exhibition.

screen. Considering these general changes in society, we can anticipate that museum visitors will be increasingly familiar with computers. Interestingly, however, the Euesperides program was also used by a considerable number of visitors with very little (7 per cent) or no previous experience (16 per cent) of their use, whereas a very small number of visitors who did not use the program were opposed to the use of computers in museums in general, not finding them useful and preferring the 'real thing'.

How Was the Program Used?

While most users found this program easy to use, there were, in general, several indications that its usability could have been improved. Because the program presented a large amount of information, including a complex set of links, it did not always succeed in maintaining ease of use. Furthermore, the introduction of an evaluation screen after only a few minutes' use of the application appeared to disrupt communication. This was programmed to appear after three minutes' use of the program and asked about ease of use and satisfaction with the level of information provided. It also asked users to select one or more adjectives from a list provided describing the program. Although the answers which visitors gave to the on-screen questions offered useful feedback, the way this evaluation screen was introduced in the Euesperides prototype disoriented and confused many users.

Visitors' gender, age, and group composition were also reflected in their behaviour and interaction with the computer at the exhibition on Euesperides. Almost 60 per cent of 117 tracked visitors used the computer in groups of two or more, which was in accordance with the findings of other studies (Doering *et al.*, 1989; Menninger, 1991; McManus, 1993; Giusti, 1994b). Most users created unique paths through the application, taking advantage of the options offered, but some general trends emerged. The analysis of the interaction logs indicated that the most popular type of navigation of all age groups was linear (36 per cent of the 391 valid logs). It appears that older visitors in particular

were more likely to explore the program in a linear fashion. Younger visitors (under 18) on the other hand, showed a greater tendency to navigate randomly and explore several areas superficially. It cannot be excluded that more extensive general use of programs and systems designed in a hypertext way, such as those available on the World Wide Web, might gradually encourage non-linear ways of thinking and exploring.

Recommendations for Similar Projects

These findings, as well as the general experience gained from the study, can be interpreted in a wider museum context. The implications of the results and the lessons learned are presented below in the form of guidelines for enthusiasts, professionals, and institutions working in the area of cultural multimedia.

Guidelines for User Interface Design

User interface design is an important part of multimedia production; a badly designed interface will make the program difficult to use and can negate impressive and rich content.

- Formative testing of the interface is vital and should be undertaken at several stages during the design of the program. This can be carried out informally with a small number of visitors or potential users.
- The application should be programmed so that it forgives users' mistakes and offers feedback about the various operations. For example, users should be warned about images which will take a long time to appear on-screen.
- Public information systems addressing a wide audience of mixed abilities and computer experience should be kept very simple. This is often difficult to reconcile with depth and complexity of content.
- Interactive programs should include some form of concept map or index, providing an indication of how much material has been included and the best way to access it quickly. This is important, because, as compared to traditional media, multimedia programs do not offer a clear indication of what is there to explore.
- When providing additional information for the more interested users, it is more effective to offer it in layers, keeping the interface simple and intuitive. Broad-ranging and information-rich applications require even more attention to evaluation, the structuring and layering of information, and the provision of concept maps, indexes, clear navigation and searching tools. These would prevent new users becoming intimidated by cluttered screens and, at the same time, they allow more interested visitors to navigate easily in greater depth.
- Important messages and content information need to be repeated in different ways throughout the interactive program and not be concentrated into the first few screens alone because visitors are likely to spend the first few minutes exploring the interface of the application and not pay particular attention to the subject content. For this reason, the main interactive features, buttons, and special effects will work more effectively when presented in the beginning, so that users can experience them and become familiar with their functions.

- If the function of navigation buttons is not immediately clear, there should be a part of the program set aside for users to test and learn what all the buttons do. The names for buttons should be chosen carefully so as to offer a clear indication of their function, especially for the benefit of users not familiar with computer terminology. Adding titles to button icons will assist communication.
- Metaphors from the real world can be used very effectively to communicate messages (e.g. the metaphor of a library or a book shelf for organizing literary sources or bibliography, and the floorplan of a gallery or museum for connecting and grouping images of different objects). Badly chosen or ill-implemented metaphors, however, can have the opposite effect. The use of metaphors must be considered carefully and tested with the users, whereas designers should also remain aware that some metaphors might have a short life-span.
- Quizzes and games can be incorporated in the application, since they are attractive to both young and old visitors. These can be used to make links to information presented in the program and repeat in a playful way messages presented previously.
- The use of sound must be thought out very carefully in a public gallery, because it can be disruptive. Used sparingly, however, it can reinforce actions and offer useful feedback to users, e.g. to indicate when an operation has been successfully completed. In some cases, it can also offer information which cannot be provided otherwise, e.g. the pronunciation of specific words.
- The use of video is demanding on software and hardware, as well as requiring special programming and design skills. It should be used only when it offers additional information which cannot be communicated in other ways, and it should always be provided with an 'escape' option.
- When introducing an electronic evaluation form into the program, great care needs to be exercised over its implementation, because it can disrupt communication seriously and disorientate users. Formative testing can explore whether introducing it as a game, making it optional or voluntary, offering a warning, or placing it at the end of the interaction, will have a positive effect. If used, it should always be accompanied by an easy 'escape' route, because users may be intensely irritated by their main exploration being interrupted by an invitation to evaluate what they have seen.
- It is very effective to program the system so that it records information about individual users' profiles, their type of navigation and the choices made. Apart from its usefulness for evaluation, this information can then be used by the program to present customized information in accordance with that user's profile and history of interaction.

Guidelines for Navigation Through Multimedia Programs

- The concept map or index provided should have active links to all the items listed so that these can be accessed directly. In addition, it is more effective when it indicates the user's present position, past moves, and available paths.
- Linear navigation through the program should be supported, as a number of

visitors are likely to prefer it. Designers should always provide a form of 'Next' and 'Back' buttons and also consider providing an electronic 'guided tour'.

- At the same time, they should exploit the power of the medium and provide, at least in parts, a more flexible, open structure with multiple associative links and alternative ways of navigating for the benefit of more adventurous users or for those who have already become familiar with the application. A variety of options and navigation styles should be provided (though without sacrificing ease of use), so as to cater for the diverse audiences of museums and the wide range of learning styles.
- When hypertext links are provided, they should be very carefully thought out. Designers should consider providing a warning to users about where the active link is likely to take them, as they can easily become confused and disorientated when navigating in this fashion.

Guidelines for Museums Considering Multimedia Production: 1. Before Becoming Involved with Multimedia

- The Euesperides project made it clear that multimedia design is a laborious, time-consuming, and demanding task. Even with a low-cost, experimental application the investment of time and effort was still considerable. In that particular case, all the design and production work for it was included in a grant-assisted research project and it was possible to obtain additional sponsorship for part of the computer equipment used in the exhibition. In most cases, however, multimedia production involves considerable costs. When moving images and video are included these costs can rise dramatically, and they are factors which museums or relevant bodies need to take into serious consideration before embarking on any multimedia project.
- Until today the financial success of a cultural CD-ROM has been very rare (Herszberg, 1997). Naturally, it needs to be taken into consideration that CD-ROMs can be physically detached and used outside the museum in different contexts from the multimedia program studied here. Furthermore, this research study did not deal with the commercial viability of museum multimedia products. Museums planning to enter the field of electronic publishing and multimedia production, should first consider carefully their preliminary feasibility and marketing studies.

Guidelines for Museums: 2. Collecting the Material

- Museum staff planning to undertake similar experiments should not underestimate the time and effort involved in collecting the material and researching the content. Several aspects of multimedia production (from programming to user interface design) can be successfully undertaken outside the museum by specialists collaborating with the staff, but deciding about the content of the application and selecting the relevant material requires the experience and knowledge of curators, collection managers, or other subject specialists. For this reason, it may be more efficient to select as the subject of the program an area which has already been well researched and published, with an abun-

dance of good quality material. Plenty of time should be allowed in the planning for evaluating the available material and for assessing its potential for communicating messages, aesthetic value, suitability for digitization, educational impact, and relevance to the national curriculum.

- If considering the inclusion of material drawn from outside the museum or organization, additional time—together with appropriate financial provision—needs to be allowed for communications with external institutions or individuals and for negotiating copyright issues. Contributors and rights need to be acknowledged in the program and the relevant objects, media, or information must be presented accurately.
- The level of information which the proposed multimedia applications will provide should be carefully considered. In the case of the Euesperides project, the majority of visitors were satisfied with a program which included a wealth of information and covered a broad range of topics. Although in other circumstances extended coverage of several topics might not be appropriate, the use of expensive hardware and software for applications with limited range and shallow level of information, in general, does not take full advantage of multimedia's potential or address a wide spectrum of the public. Interactive applications often inspire heightened interest and curiosity, which they should then be able to satisfy.
- Capturing cultural information and its meaning on computers is a very complex process, as the simple acquisition of data—the mass of detailed information—does not in itself convey the content. In most cases, the current utilisation of information technology presents data rather than the information content, and thus fails to enlighten or teach anything. Museum professionals, especially curators and collection managers, need to understand what the users want to see—for what they are asking. We need to overcome our fascination with the technology and the mass of data which we can process with computers, and we must not fail to recognise that “the reduction of information humans necessarily do without technical help, is not only a loss, but a deep intellectual process to find out what is relevant, what is worth being taught, what we should learn” (Doerr, 1996). On the other hand, the free association of data through a computer screen can potentially assist in a synthesis of cultural puzzles, and the construction of a holistic picture from rudimentary fragments of information.
- When preparing the content, it is useful for museum staff to keep in mind that visitors are very interested in information about people and their lives and are often assisted by the personalization of otherwise bare facts. Additionally, humour, when used with discretion in a particular application, can be a very powerful and effective way to communicate ideas.

Guidelines for Museums: 3. During the Design Process

- The design of cultural multimedia is inherently an act of interpretation and communication. Even when multimedia production is commissioned outside, the museum staff must be closely involved so as to ensure that the choices made are those of their institution and that the messages communicated are those intended.

- There is a danger of multimedia programs being presented as absolute truth or the only authoritative interpretation. The technology can be used, instead, in a more powerful and liberating way to make available alternative views, set out dispassionately fascinating problems, and admit doubt and uncertainty when it exists.
- The design of multimedia is a very creative process, requiring imagination and a wide range of skills. Although for practical reasons all production stages of the Euesperides program had to be carried out by one person, it became very clear throughout the design process that these programs should ideally be the product of team work. For the design of successful educational and interpretative applications a balance needs to be struck between the technical requirements, the artistic presentation, and the content. It is debatable who can best meet the requirements asked of this new type of multi-talented professional. In my personal opinion, for any successful undertaking in cultural multimedia, it is necessary for both museum professionals and subject specialists to have an understanding of the technology and an ability to reach a public beyond their peers, and for the computer experts to be enthusiastic about museums and understand their educational role and special character.
- For many museums the decision to use interactive multimedia involves creating partnerships with other museums, universities, and cultural organizations, as well as interacting with the commercial world of production companies and technology consultants, often in different countries. This tendency will probably increase in the future, and can prove very useful, but only so long as humanists and museum staff keep an open mind about the benefits to be derived from the new technology, together with a dose of healthy scepticism about the exaggerated claims made of it and wariness of the pitfalls involved. Keeping in touch with new developments, accumulated experience, constant research, and careful evaluation can help them to make informed decisions.
- A larger body of knowledge needs to be built up before we can generalize about the characteristics of users of museum computer interactives. The profile of the users of the Euesperides prototype indicated that the common belief about the attraction of the medium being mainly for young children and male computer enthusiasts is not always confirmed by real research and observation, and any decision to incorporate interactive programs in an exhibition does not necessarily exclude a large section of its audience.
- It is important not to design these programs in a gender-specific way. The Euesperides study showed that female and male visitors were equally likely to use the computer program. The expansion of the use computers in society is diminishing any differences in their use and exposure as between the sexes. Designers of multimedia programs need to be careful that the language, metaphors, and icons used are not excluding female users.

Guidelines for Museums: 4. Integrating Multimedia in the Exhibition

- The attraction of interactivity should not be underestimated when preparing exhibitions, especially when this is implemented at an advanced level, with a system which encourages user input, offers customized information accord-

ing to the characteristics of different users, and incorporates computer simulation and role-playing metaphors. This human-computer mode of communication, endowed with the ability for visitors to select from a rich store of material which particularly interests them, and choose the way it is presented, is one of the particular features of multimedia which cannot be offered by more traditional means of museum presentation.

- The use of intuitive and user-friendly interface devices and hardware which reduce any technophobic predilections of visitors is likely to provide better communication to the real information content, even if the first few minutes of interaction have to be devoted to exploring the interface.
- Despite the attraction of the medium, the average time which visitors will spend with a multimedia program in a public gallery is still likely to be under 10 minutes. In the case of the Euesperides project, it was between 3.7 and 7.7 minutes on average (2.2 to 5.6 minutes median time). Having said that, it cannot be excluded that a more advanced computer program, or a topic more attractive and accessible to a wide audience, might significantly increase the period of interaction.
- Multimedia applications have particular strengths for archaeological displays. Their ability to provide an idea of the original context of the objects on display, as well as an explanation of archaeological work itself, were particularly attractive to the public in the exhibition on Euesperides. Visitors greatly appreciate graphics, photographs and video-clips of where and how the objects were found; visual information on other archaeological features which cannot be displayed in the gallery, such as buildings, earth works, and town plans; information on how these were made and used, e.g. how pottery or bronze statues were made; reconstructions and models prepared by the excavators, alternative interpretations; and explanations of concepts like stratigraphy and the grid method. Interactivity can also be used to invite active participation by the users, by placing them, on-screen, in the excavator's role in a simulated archaeological trench. Some of these ideas are applicable to other museum presentation methods as well, but multimedia can combine these features in a particularly effective way.
- The ability of the system to accommodate group interaction needs to be seriously considered. Museum professionals need to investigate the rapid developments of the technology in this direction (wall-size displays, 'slave' monitors, hand-held devices, visitor-aware interfaces) and the possibilities for extending the human-computer communication to include more than one visitor and thus accommodate the social character of the museum experience.
- Exhibition designers face a particularly demanding task when designing programs which expect visitors to observe or relate the physical exhibits *simultaneously* with what is displayed on screen. Extensive planning and testing is necessary for this direct linking to succeed.
- The computer should not be chosen as the sole medium for communicating messages. There will always be a section of the public, even if it is small, which is not attracted to computer programs and disapproves of their use in exhibitions. Exhibition designers should also strive to provide computer-free spaces for undistracted recollection, contemplation or discussion.

After the Opening of the Exhibition: the Importance of Summative Evaluation

In any evaluation study the identification of appropriate criteria is vital. Although these always depend on the scope and purpose of the specific study and the aims of the multimedia program, it is important to combine criteria about:

- the user interface and presentation;
- the structure and navigation;
- the programming;
- the content;
- the integration with exhibition/museum display; and
- overall impressions and effect on visitors.

The experience gained from this project has also been helpful for evaluating the evaluation tools. Used on their own, none of them would have offered sufficient evidence for understanding the complex experience of the museum visit and how it is affected by the presence of the computer station. In combination, however, they illuminated different aspects of a multi-faceted phenomenon. For any museum evaluation the choice of specific methodological techniques depends on the questions to be investigated. What can be suggested in general, however, is that a combination of different methods should be used when evaluating the effectiveness of these programs in cultural and educational settings. The experience from the Euesperides project has highlighted the importance of conducting evaluation research of this type in the natural environment, or if this is not practicable, in a naturalistic environment, closely resembling that in which the application will finally be placed. In-depth evaluation studies of cultural multimedia need to take into account the specific character and atmosphere of the museum or exhibition under study, as well as the physical, social, and personal contexts of its visitors, since all these factors affect the way in which visitors will interact with the computer program (Falk and Dierking, 1992).

Beyond Euesperides: A Wider Perspective of Museum Multimedia

The findings of this study have showed that one type of computer interactive attracted and engaged visitors in Oxford and enhanced their experience from the specific archaeological exhibition. Under different conditions, in a different setting, and with different material, multimedia interactives might not have been appropriate or effective. Before making the decision to use multimedia interactives, museums need to consider carefully whether this medium is the one best suited to the task in hand, taking into account the technical, financial, aesthetic, and pedagogical implications.

Multimedia applications are just another tool for presenting and interpreting objects and ideas. Museum professionals need to become familiar with its strengths and weaknesses, so as to control uncritical enthusiasm as well as technophobic resistance. In any museum presentation, the emphasis has to be on the message, not the medium. However, the experience from the Euesperides project and other findings are showing that the power and attraction of the medium are very impressive and can in certain circumstances be effective in attracting visitors to receive the message successfully.

Despite the constant activity and developments of the last decade, the potential of this technology in the cultural sector has not yet been fully realized, and the emphasis should be directed towards deeper understanding and research. The leading role needs to be given to the museums and humanities sector, rather than to computer science which can only play a supporting role in this path of exploration of how culture is perceived through a computer screen. Closer collaboration between content specialists, program designers and educators can play an important role in this direction. Furthermore, systematic testing and rigorous investigation, as the Euesperides research study has shown, can help to make interactive multimedia effective interpretation tools which enrich the experience of museum audiences, both real and 'virtual'. I hope that the findings and observations generated here will be of general use in the creation of powerful and attractive applications that assist the understanding of objects and the communication of ideas.

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