Integrating Cultural Heritage Activities in Education Process: Experiences and Perspectives through New Technologies

Eugenio Morreale [*]

[*]Dipartimento di Informatica, Università di Pisa, Italy

E-mail: morreale@di.unipi.it

ABSTRACT

In this paper we first outline why pupils should be given the opportunity to visit and have direct contact with the cultural heritage. We then propose some 'didactic itineraries' organized by museums and other cultural institutes which are aimed at specific subjects and ages of pupils. We illustrate the main organizational aspects and the people involved in the various stages of the project. In particular, we refer to the Didactic Communicative Intermediator (DCI) who is the main person who guides the communicative, psycho-pedagogical and cognitive needs of the pupils. Through the DCI, pupils can acquire the target concepts and notions of the itinerary and can integrate these with those developed in the normal classroom activity of the pupils.

KEYWORDS: Internet based educational systems, computer assisted learning and instruction, authoring tools and methodology, collaborative knowledge construction using networks and the WWW.

INTRODUCTION

Nowadays schoolchildren are bombarded with all sorts of information in all kinds of forms by all types of media. In such a context, it is interesting to consider how the new media and technological supports may favour direct contact with museums and other cultural institutes, in the sense that these are real as opposed to virtual environments, which contain vast amounts of documents and examples through which (and through the musem staff) we can teach pupils a wealth of notions.

Involved in all this, is the emotional aspect of what the pupils actually feel when face to face with new environments, new objects and subjects, and new people. With the right preparation by the teachers, this leads to new experiences and a new way of learning; and this becomes a particularly enriching experience if well integrated into the daily classroom activities. One way to ensure this integration is the use of well designed and realized 'didactic itineraries'. These are specifically designed and realized for particular subjects and age groups and made available via the museums computer/electronic channels. They act as a base for the preparation, carrying out and 'conclusion' by the teachers and the pupils of the visits and a meaningful integration of the whole experience.

Using our recent experiences in this field, this paper will attempt to highlight:

- An example of design of a

dedicated didactic itinerary ("Mammals") formulated by a natural sciences museum for primary school pupils, in order to evidence the complexity, richness and importance of well conceived direct contact for/with the pupils on that basis,

- the overall potential offered by the latest technologies in the development and production of didactic itineraries in addition to various technical / organizational aspects. We will also focus on the people in charge of conserving the cultural heritage in terms of the design, development, production, documentation and maintenance, etc. of such didactic itineraries;
- The didactic aspects and the "didactic communicative intermediator" (DCI), whose role is to coordinate the comunicative psychological and cognitive impact towards the pupils and involve teachers in integrating everything into the scholastic activity,
- Some further considerations and conclusions.

DIDACTIC ITINERARIES: A CASE STUDY

Some of the main points why school visits and direct contract with museum and other promoters of the cultural heritage help to enhance the didactic potential are:

- such experiences can be *integrated* into the everyday school activities, and thus
- characteristics according to which the *visit is prepared and carried out*, and thus also
- *communicative, psycho-pedagogical and didactic bases*, according to which the didactic itinerary was conceived, designed and carried out.

If these factors are not fully considered then the visit merely becomes an escape from the usual school routine, which only superficially touches the pupils and leaves them nothing concrete to take away. This may be the result even if experts are on hand, who although having the best of intentions may use too technical language or refer to complex ideas that go beyond what the pupils can deal with, or other psycho-pedagogical factors (see following point) that the expert may ignore and neglect.

As an example of a possible approach toward the design, structuring and offering of didactic itineraries, below we summarize the fundamental psycho-pedagogical and the main structural aspects of the **"Mammals"** itinerary [1, 5] in its original version, which was conceived and designed for primary schoolchildren (~8-10 years) by Berni and Zuffi, who have primary school teaching experience (as Didactic Communicative Intermediary DCI, see next Sect.) alongside research in zoology (as Expert in Specific Fields ESF, see next Sect.) respectively, at the Natural History Museum of the University of Pisa (henceforth, the Museum) under the direction of Prof. M. Franzini.

For a detailed description of the design and implementation of the "Mammals" didactic itinerary, see [1, 5]. Here we summarize the main elements of its psycho-pedagogical and didactic structure and the activities suggested for (teachers and) students.

Psycho-pedagogical bases of the itinerary

The main aim was to help children to understand, in this case through observing the skeletons of 10 species of mammals, the relationship between the

variances found and the functional adaptation needs to the environment. The starting and reference point is a human skeleton, ie the skeleton of the children themselves. This is used to show the children how they perceive it and how they schematize such perceptions. The children then compare this human skeleton with the skeletons of the mammals, again on a perception/sensory level. This enables them to hypothesize on why changes have come about in the structure of the various mammals.

Understanding how and why mammals diversify and are transformed as a reaction to the environment, helps children to focus on natural processes (above all in the animal world), and offers a dynamic perspective on the interactions between life environments and the physical characteristics of the organisms.

The itinerary is based on three main factors: (i) establish what the children already know; (ii) limit the work to mammals, specifically those which can be compared to a basic skeleton structure (10 animals); (iii) get children to give plausible explanations for these variations in terms of function, and adaptation to the environment, without any quantified time references.

This rationale entails radically altering the traditional approach to museums, where visiting classes are accompanied by an 'expert' who imparts knowledge, often in overly technical language, with questions being left to the end. Instead in our case, it is the children who ask the questions from the outset, the role of the expert being to guide the children in their discovery of the distinctive properties of the various mammals.

The underlying concepts of this didactic itinerary derive (i) from Piaget's ideas [8] on the formation of thought in children, and later studies on its 'magic' tendency [2], (ii) from research [9] into conceptual maps in children's thought, and (iii) from studies on preconceived ideas that may condition learning. A child's preconceived ideas on any subject covered in a syllabus must be known, so that teachers will ask the 'right' questions. In answering, the child will objectify his/her knowledge and will thus interact with the subject of learning. This interaction should modify any erroneous preconceptions, thus leading to a correct, stable, and lasting knowledge. When children are free to test out their own ideas and to compare these ideas with their companions they will be able to build their own knowledge through this social interaction. In this case the teacher takes on a new role as stimulator and mediator.

Didactic structure

The planned main Objectives and Activities and their detailed stages can be summarized as follows.

Objective: *distinguish between mammals and non mammals*

Activity: children (i) divide pictures of animals into sets of mammals and non mammals using their own reasoning; (ii) compare criteria underlying their selection; (iii) if necessary, integrate their knowledge with simple information;

Objective: *find out which animals were really recognised by the children*

Activity: children (i) write a free list of names of the animals (mammals and others) that they claim to know; after some time, (ii) teacher gives the list back to the children, and (iii) get them to write down what each animal eats and where it lives;

Objective: *investigate what perception children have of their own skeleton within the body scheme*

Activity: children (i) do a

spontaneous and free drawing (without giving them any clues); (ii) get children to touch their body, telling them verbally which specific parts to touch, children now (iii) do a spontaneous and free drawing; (iv) use physical exercises so that children get a better perception of how their bodies are articulated; (v) children draw a skeleton, within the outline of a human body, on the basis of knowledge learned in the above physical exercises.

Main activities proposed to students

Bearing in mind the activities, the operating phases, and the worksheets outlined in previous Subsections, we will now describe only some of the pupil activities.

Maze game. In this game children find themselves in front of a maze in which there are animals - mammals and non mammals. The aim of the game is to follow a path along which there are only mammals. This is not that simple since when the child makes a mistake he/she is not warned of this immediately but only at the end.

Formation of sets The page on which the activity takes place shows two sets, one for the mammals and one for the non mammals, and a number of animal icons with the name of the animal underneath.

Skeleton colouring. On one side of the screen is a complete human skeleton and on the other side a dismantled skeleton. Pupils have to colour (using a colour palette) the skeleton parts using the same colours as in the complete skeleton.

Composing skeleton. The human skeleton is composed by dragging the individual elements to the outline of the human body. If the elements are not located correctly then they are automatically rejected. The pupil gets three chances, after which the positions are recorded. If the pupil gets the right result he or she is free to display the four main positions of the composed skeleton (from in front, behind, and from both sides) or to see a 3D animation which shows the rotation of a human skeleton.

TECHNICAL AND ORGANIZATIONAL ASPECTS: THE MAIN ACTORS

On the basis of the didactic itinerary outlined in previous Section, our subsequent experiences [6] represented a consistent evolution in fully exploiting technological potentialities in the field of education through cultural heritage activities, related to both the following points:

A) Whole System Conception

1. we broadend the overall consideration of the technical infrastructural tools with which to equip a Geopaleotology Museum realized in the Lerici castle, as for example with: robotics, seismic platform for earthquake simulation, etc. [4],
2. we structured the whole system architecture on a client-server basis,
3. we integrated the Hypermedia, Data Base for data management and storage (in order to give stability, continuity and permanence to the scheduled applications) and Communication Network technologies by introducing dynamic web pages construction for answering remote users requests,
4. use of sophisticated data, eg 3D interactive graphics, to enhance the communication of cultural heritage specimens (various graphic- 3D models, animations, etc, with consequent possibilities of:"navigation" in / "manipulation" of 3D models)

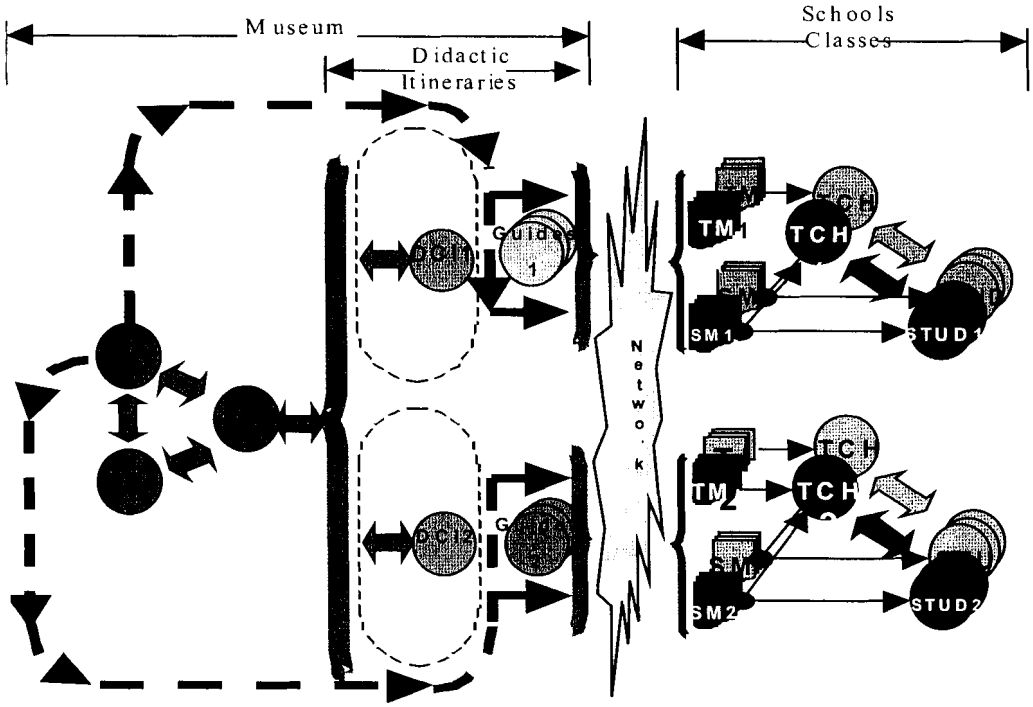

Fig. 1 People involved, Processes, and Interactions in Museum -School Applications

B) Specific Methodology on main Technical and Organizational aspects so that, thought their joint application, new paradigms and organizational structure of technologically aided activities for:

1. organization, conception, design, development, offer, documentation, update and maintenance, etc of didactic itineraries;
2. coordination, connection, maintenance and contacts with: (i) schools / classes, (ii) publishers / textbook authors;
3. new services allowed by the technology in the field of the cultural heritage as for example those concerning:
   - contacts with other Museums, institutes dealing with cultural heritage,
   - services for schools, teachers,
   - coordination-Links offered to textbook authors and school publishers,
   - coordination-Links with local organisation for administrative school functions, touristic promotion, etc.

rich and meaningful innovations could be expressed and realized, as for instance,

This was further developed [6] by: integrating specific functionalities of Hypermedia, Data Base technology and Telematics, i.e. remote network communication, in order to:

1. give continuity and stability to the applications via an open approach to the gradual enriching and updating of the presentations through dynamic (most recent) data alignment within web page building;
2. allow for the accumulation and adaptability of the data;
3. enhance and make more involving the communicative and didactic potentialities of the informative materials via interactive access;
4. facilitate the identification of relevant data and means of presentation specifically for educational purposes, via various levels of data definition and organization;
5. widen the possibility of adapting the materials to various uses by different typologies of: i) users (students, teachers, guides, museum workers, visitors, specialists, etc); ii) application environments (schools, training, distance education, diffusion of culture, etc); iii) means of exploitation (local, remote, deferred access), etc, through a proper and rich schema and subschema data structure;
6. facilitate the re-use of the same information in different applications, in order to reduce production and maintenance costs, in particular in relation to expensive data, eg 3D interactive modelling.

The original version using 'traditional' data (texts, images, films and animations), was then extended to 3D interactive graphics to enable users to "work" with the models and examine them in detail [6]. The system was tested on widely different applications:

- on historic buildings and architectures, (historical aspects, materials used, building techniques, degradation, restoration, etc.) and taking down and rebuilding the "interior" medieval tower of the Lerici castle,
- on natural fauna and paleontological samples of an Ammonite (interactive atlas, shell sectioning, internal parts, reproduction of the functioning of the internal organs, simulation of behaviour etc.).

For a museum a similar approach can also facilitate the use of just one model (in particular for interactive 3D graphics) for many different applications thus allowing the overall costs in the development of Interactive 3D Network Applications to be reduced [6].

Let us refer to Fig. 1, where didactic itineraries are used to introduce and integrate scientific and cultural topics, in order to discuss main technical / organizational aspects and the main people involved (see circles in Fig. 1).

With reference to the left part of Fig. 1 note:

- the areas of the museum and school that the various people involved belong to,
- at the centre is the area related to didactic itineraries with the museums as producers and the schools as mediators to the end users, ie the pupils,
- people involved in scientific/ technical aspects of Museum activity for hypermedia preparation and offering; in the left part (Museum area) we notice:

ESF (Expert in Specific Fields), one or more experts

who will guarantee scientific validity of presentations;

SA (System Administrator), who ensures the integrity of the data, system and its functioning;

DP (Data Provider) who will propose and develop not only multimedia data, hypermedia and electronic solutions but also special effects (eg as in video games);

- and their relationships (see ⇔ in Fig.1) in the various technical phases of: acquisition of data, identifying the functionality of applications, design of interactive 3D applications, etc., until presentation,

and furthtermore, note also the processes:

P1 **design and production of support materials** by cooperation (⇔) of DCI, ESF, DP and SA,

P2 **make didactic materials available** to schools; two itineraries are shown (large dashed lines), each one accessed by two classes (different grey / colour shading)

P3 **interpretation and intermediation** (⇔) by school teachers with the pupils,

with the main people involved (see central and right part of Fig. 1). Specifically, with reference to any of the itineraries shown:

Within the Museum: People involved in the design and use of the didactic itinerary:

DCI (Didactic Communicative Intermediary): the central figure who designs, defines and implements (with ESF and DP) the didactic itinerary (**P1**),

Guides: the central figures of the museum who exploit predefined didactic itineraries and who will be the live voice in exploiting the itinerary; they also help teachers to prepare and carry out the visit (**P2**);

Within the Schools: People involved in the use / exploitation of class work, in contact work for extra mural activities and in the integration between the two types of work and experience **(P3),** ie more specifically:

TCH Teacher, ie the main component for the proposal and the integration of the didactic itinerary with the didactics carried out in class, both in the preparation / conclusion of the visit and in enhancing the programme in institutional terms,

STUD Student, ie the "end user" of the proposal and presentation of the itinerary.

DIDACTIC ASPECTS: THE DIDACTIC COMMUNICATIVE INTERMEDIATOR (DCI)

Let us briefly summarize here:

- the central role of the DCI, by highlighting its main functions with reference to previous Example "Mammals" [1, 5],
- the reverberations on the teacher's activities that makes the itinerary possible for the pupils (P3).

The DCI should define:

- Psycho-pedagogical bases for the itinerary,
- Means for their use in the design and development of the itinerary.

In the case of the "Mammals" itinerary, the didactic itinerary should thus:

- directly and actively involve pupils who have to put into action and play the discovery of their own skeleton and those of their

companions as a basis on which to compare those of animals (via the Museum),
- brainstorm their own knowledge and ideas on some animals, body parts and notions drawn from tales, pictures, animations, TV, etc.,
- offer tools that gain pupil's attention in motor and brainstorming activities (eg via fact sheets, drawings, materials to cut up / models / colours, eg The Maze Game, Formation of Sets, Skeleton Colouring, Composing Skeletons, etc.),
- offer feasible organization of the visits,
- offer feasible didactic verification of outcome of visits.

When carrying out these functions the DCI needs to:

within the museum collaborate with ESF, DP, and Guides in the design and development stage,

towards 'users' give attention / listening to:

teachers in order to be aware of their behaviour and any conditioning, their being more or less informed, willingness / resistance not only towards technological tools and support, but also in relation to didactic approaches inherent in the choice of subjects proposed and, above all, of the methods of presentation and discovery of these subjects (P3),

school children who in relation to their vision of the world – both technological and school – make a very useful source of ideas, behaviours, preferences and idiosyncrasies, which are often difficult to collect and understand appropriately by adults [3].

In relation to class work (P3), among the reverberations of the approach adopted in out example towards the teachers TCH, some may be connected to their willingness and ability to:
- manage: preparation, actual visit, verifications, etc,
- take on new subjects and approaches that they might be a little wary of,
- question their own methods,

with possible consequences on carrying out the stages of the itinerary and its conception.

Trying to summarize the main characteristics of a good DCI, let us say that s/he should be able not only to filter, choose, select and organically and harmonically compose inputs, proposals and possibilities coming from ESF, DP and school world, but s/he should be able mainly in the sensibility for inventing new solutions, propose and realize new ways of thinking and suggest activities which stimulate similar attitudes both in pupils and teachers.

Through the suggested approach and the related technological tools new form and help is given to:
- organization, conception, design, development, offer, documentation, update and maintenance, etc of didactic itineraries [7],
- coordination, connection, maintenance and contacts with: (i) schools / classes, (ii) publishers / textbook authors.

FURTHER CONSIDERATIONS AND CONCLUSIONS

The proposed approach facilitates, more than in the past, the contact and integration between:
- aspects of different disciplinary pertinence,
- extra mural activities carried out and supported by external institutions with internal school

activities.

Such possibilities of teaching/ learning in contact with realities outside the school should stimulate pupils:

1) in the perception of:

- aspects that they might otherwise miss,
- complexity of the web of interactions that might occur between these aspects, and specifically the size of the evolution processes and changes,
- multiplicity of the points of view in which such aspects can be considered;

2) to:

- elaborate and express their own interpretations, points of view, etc.,
- collaborate with others while reaching their interpretations, and assessing each other's points of view;

and at the same time encourage teachers in a more active and collaborative way to participate in carrying out their role as educators.

The organizational means that we have outlined can help make what would otherwise be one-off events organized by individual teachers and 'enlightened' heads of schools into something more frequent and structured.

Achieving all this has clear implications:

Museums, environmental and cultural institutes need to be able to organize what they have to offer and provide the relevant support. Moreover, the educational centres themselves need to prepare the staff who can be involved in such projects, particularly the DCI. Teachers, too, need to be prepared to be open not only to new technologies, but above all to the new related potentials, experiences and didactic approaches.

With reference to the applications of technological supports and their innovative use, let us summarize here the following aspects:

- use of sophisticated data, eg 3D interactive graphics, to enhance the communication of cultural heritage based on technology (various graphic- 3D models, animations, etc, with consequent possibilities of:"navigation" in / "manipulation" of 3D models);
- new and easier approaches to creative, technical and organizational cooperative activities mainly by DCI, ESF and DP, as recently proposed for didactic itineraries' design, implementation and dynamic updating and maintenance [7].

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ABOUT THE AUTHOR

Eugenio Morreale is Associate Professor at the Informatics Dept. of the University of Pisa. He has made research work in many areas of Computer Science and related fields and applications (Switching Theory, Medical Records and Hospital Management, Natural Language Processing, Informatics in School and Education, Social and Cultural Aspects of Informatics) and in recent years works in the design of Hypermedia and related Applications in the fields of Education and Cultural and Environmental Heritage enhancing.
E-mail: *morreale@di.unipi.it*