Integration of External and Internal School Activities: Support from New Technologies

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Abstract
The paper examines some of the ways new technologies can be used to integrate external experiences (eg museums, natural parks) into traditional school activities. For this purpose, we present the main design approaches adopted in the design of: a) a system for highlighting the role of a museum in teaching natural sciences in primary schools; b) the technological infrastructure INformatic- TElematic- RObotic (IN.TE.RO.) for a Geopaleontology Museum; c) a methodology and a development system for presenting Cultural Heritage collections through "traditional" data (texts, images, films and animations) as well as through interactive 3D graphics. Both the methodology and the development system have been tested on widely different applications (historic buildings and architectures on the one hand, and natural fauna and paleontological examples on the other). From these experiences the most relevant choices and results on technical, organizational and didactic aspects are presented together with the rationale behind this approach.

Keywords
Internet based educational systems, Computer assisted learning and instruction, Authoring tools and methodology, Collaborative knowledge construction using networks and the WWW

Introduction
Computer-aided education is characterized by an increasingly wider variety of technological tools to help the teaching/learning process, distance learning and the spread of culture (through museums, environmental and cultural itineraries, institutions, etc). The aim is to raise the curiosity and awareness of users by stimulating them with lively and attractive images and involving them in choosing and directly carrying out actions on objects representing the topics of interest, either working independently or by interacting with others at different times and/ or locations.

In these conditions the possibility of interactive operations as well as of remote communication become of paramount importance. By exchanging information and planning common aims, an open environment can be set up, in which a variety of people (students, teachers, guides, instructors, moderators) within the same or different organizations can work together. On the other hand, it is also increasingly important to give stability and continuity to applications, and be able to reuse informative materials in various applications.

Assuming "Informatics" as: "The interdisciplinary study of information content, representation, technology and applications and the methods and strategies by which information is used in organizations, networks, cultures and societies" (Bearman & Trent, 1999), in this paper we look at some of the ways traditional school activities can be enhanced by using new technologies to integrate them with external experiences (eg museums, natural parks, cultural centres). For this purpose, we outline some experiences in the use of technological tools in teaching and presenting the cultural heritage, specifically:

➢ the most relevant aspects of these experiences,
➢ how new technologies can develop pupils creativity, larger mental outlook and awareness

These experiences are summarized chronologically below (see also Fig 1).

(1) A project organized by the Natural Sciences Museum of Pisa University to set up a computerized didactic itinerary ("Mammals") for second cycle of elementary classes (Berni et al., 1996; Morreale et al., 1997); the informatic-telematic system is aimed at aiding teachers and students to achieve the didactic and cognitive approach planned on the basis of the experience offered to and experienced by the students.

(2) A project based around the information system (IN.TE.RO) at the Geopaleontological Museum in the Lerici castle (Morreale et al., 1996), showing various paleontological exhibits with related images, texts, animations,
3D-graphic and robotic models (Allotta et al., 1999) as well as equipment for seismic simulation; data about the castle and its contents can be accessed by remote users (visitors, students, specialists etc) who can receive a wealth of useful information.

(3) The definition of an approach for presenting information on the cultural heritage (Morreale et al., 1999; Morreale et al., 2000), characterised on a technical and organizational level by: i) a specific methodology centred around Data Administrators (DA), Experts in Specific Fields (ESF), and Data Providers (DP) whose interaction can be realized in any specific applicative context through ii) a set of functions and support tools. This basic approach integrates specific functionalities of Hypermedia, Data Base technology and Telematics, i.e. remote network communication, in order to:
1. give stability and continuity to the applications;
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. 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;
5. 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.

(4) Some remarks on didactic aspects within Museum projects specifically oriented to those involved in teaching (Morreale, 2000), which have been further detailed and expanded here.

These experiences will be referred to in a logical rather than chronological order following two ideal “coordinates” (Fig. 1), related to:
1. technical and organizational aspects (see related Sect.),
2. teaching and educational aspects (see related Sect. and the following devoted to "Design, Structuring and Offering of a Didactic Itinerary").

![Figure 1. Chronological and Logical exposition](image-url)
plus briefly a third coordinate
3. rationale behind the system adopted in relation to stimulate the creativity, larger mental outlook and awareness of the students (Sect. on General remarks);
finally some conclusions will be drawn (in final Sect.).

**Technical and Organizational Aspects**

In (1) (Berni et al., 1996; Morreale et al., 1997) we began with a specific pre-existing project designed by experts from the museum with experts in psycho-pedagogy (see Teaching and Educational Aspects Sect.), on which we then gave:

*in the preparatory phases of the experience:*
- help to teachers and museum staff to exchange ideas on the didactic itinerary (preparation and execution of visits),
- the possibility to exchange ideas with teachers who had already had the same experience,
- support tools for the teachers to assess and manage their pupils’ activities,

*in the execution phases of the experience:*
- materials for teachers and pupils.

In the starting phase of second project (2) (Morreale et al., 1996) we focused mainly on the need to:
- Manage, present and promote, by integrating hypermedia and database technologies, the Lerici castle museum materials through local and remote access (via networks) or through CDs;
- Set up video-conferences to facilitate exchanges with other museums and institutions on the occasion of important scientific and cultural events (Morreale et al., 1998).

This was further developed in (3) in order to:
- facilitate the identification of relevant data and means of presentation specifically for educational purposes (see Teaching and Educational Aspects Sect.), via various levels of data definition and organization;
- give continuity and stability to the applications via an open approach to the gradual enriching and updating of the data tied to an alignment of the presentations through dynamic web page building.

To exploit the potential of technology in the field of education in the cultural heritage on a client-server basis, we integrated the Hypermedia, Data Base and Communication Network technologies (Morreale et al., 1999; Morreale et al., 2000) on the basis of:

* a specific methodology, related to the main people involved (see circles in the left part of Fig. 2):
  - 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) (Druin, 1999);
* and their relationships ($\Rightarrow$ in Figs.2, 3) in the various technical phases of: acquisition of data, identifying the functionality of applications, design of interactive 3D applications, etc., until presentation, a tool package to easily start up and apply the methodology.

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 (Morreale et al., 2000).

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 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 interactive 3D graphics) for many different applications thus allowing the overall costs in the development of Interactive 3D Network Applications to be reduced (Morreale et al., 2000).

From a didactic point of view (see details in Teaching and Educational Aspects Sect) this approach supports teachers in preparing visits and organizing working materials for the pupils, and helps the pupils to transfer the results of classwork to the museum (Fig. 3).
Teaching and Educational Aspects

On the basis of:

a. the positive experience (1) based on the use of a didactic itinerary tailored by theme, curriculum and pupil age,
b. exploiting an open and flexible system (3^) for the management and presentation of materials on the cultural heritage,

in (4) we extended the original general approach (Morreale et al., 1999; Morreale et al., 2000) to a case where didactic itineraries (Fig. 2) are used to introduce and integrate scientific and cultural topics (Morreale, 2000) as indicated in a).

With reference to Fig. 2:

- 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,
- note also these 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 (grey shading)
  P3 interpretation and intermediation (⇌) by school teachers with the pupils,

with the main people involved (see circles in the central and right part of Fig. 2). Specifically, with reference to any of the itineraries shown:

- Within the Museum: People involved in the design and use of the didactic itinerary, methodology and environment, ie:

  P1) the central figure is the DCI (Didactic Communicative Intermediary) who designs, defines and implements (with ESF, DP and SA) the didactic itinerary;
  P2) The museum guides 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.
Within the Schools: People involved (P3) 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, 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.

Here are a few further details on Figs. 2 - 3.

n1 The roles of particular people, eg DCI, may be many sided and be covered by more than one person.
n2 At the end of the experience pupils may have produced their own interpretations (BS) which, after revision by the teacher (BT) and made available to the DCI (Fig. 3), could be used to update/ enhance the multimedia archive and thus subsequent presentations by museum.
n3 The DCI (in thin dashed oval) may not belong to the museum but may have set up an itinerary which could then be left to the museum (eg ESF and/or guides) to follow up with an offer to the classes.

Let us briefly summarize here:

- the central role of the DCI, by highlighting its main functions with reference to Example (1^) “Mammals” (Berni et al., 1996),
- the reverberations on the teacher’s activities that makes the itinerary possible for the pupils (P3).
- The DCI should define:
  - Psycho-pedagogic bases for the itinerary,
  - Means for their use in the design and development of the itinerary.

In the case of the “Mammals” itinerary, on the basis of the psycho-pedagogic references adopted, and assuming as 'main theme' that of the skeletal structure of mammals and the variations that occur due to environmental conditions, it begins with:

- a perception of pupil’s own skeleton,
- give attention to pre-knowledge and ideas that might condition a child’s self-building power.
- 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, 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 (Druin, 1999).

In relation to class work (P3), among the reverberations of the approach adopted in (1^) 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.
Design, Structuring and Offering of a Didactic Itinerary

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 (Berni et al., 1996) in its original version, which was conceived and designed by Berni and Zuffi, who have primary school teaching experience (DCI) alongside research in zoology (ESF) respectively, at the Natural History Museum of the University of Pisa (henceforth, the Museum) under the direction of Prof. M. Franzini.

a) Psycho-pedagogical basis 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 (Piaget, 1966, Piaget, 1973) on the formation of thought in children, and later studies on its 'magic' tendency (Donaldson, 1979), (ii) from research into conceptual maps in children's thought (Pontecorvo, 1986), and (iii) from studies on preconceived ideas that may condition learning (Berni, 1989). 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.
Back in 1954 Dewey had already envisioned this as the role of the teacher in an 'active school' (Dewey, 1954), even though this was only an intuition that was not objectified by the psychological processes with which child learning takes place.

b) Didactic structure

The Objectives and activities and their detailed stages can be described as follows.

<table>
<thead>
<tr>
<th>Objective</th>
<th>distinguish between mammals and non mammals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>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</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Objective</th>
<th>find out which animals were really recognised by the children</th>
</tr>
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<tbody>
<tr>
<td>Activity</td>
<td>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</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Objective</th>
<th>investigate what perception children have of their own skeleton within the body scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>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</td>
</tr>
</tbody>
</table>

Stage 1: External exploration First visit to the Natural History Museum for an initial contact with the 10 animals and some first hypotheses on changes and variations in their structure.

Stage 2: Internal exploration Children's knowledge of around 10 animals is compared to form the basis of Venn and Carrol diagrams founded on a 'similar-different' relationship. Reproduction, behaviour with offspring, nutrition, and habitat are considered especially in terms of internal structure vs external coating (ie the relationship on which the Museum is organised).

Stage 3: Cognition Children fill in some worksheets regarding the animals. The first sheet is filled in either individually or in pairs, and uses questions to guide children in observing physical and functional characteristics. The second sheet is read collectively, and gives information on the animals habits, habitat etc.; children can make comments and additions at will.

Stage 4: Revision Continuous revision using diagrams on the basis of new information on the animals.

Stage 5: Control Second visit to the same sections of the museum. Children meet with expert who gives information, settles curiosities, answers questions, and resolves any problems that came up in the first visit. The relationship between expert and visitor is traditional; this is a control stage since from the type of questions that the children ask, their level of attention, motivation and interaction can be assessed. Teachers should be arousing curiosity without answering the resulting questions.

Stage 6: Verification Children complete five worksheets: 1) children separate mammals from non mammals; 2) from a given number of possibilities, children identify the characteristics of a mammal's skeleton, and freely describe the behaviour of mammals towards their offspring; 3) children distinguish a mammal's skeleton from a non mammal's, giving explanations; 4) children locate some mammals, on the basis of their habitat, in some Carrol diagrams; 5) for the 10 given animals, children identify what has changed in the internal/external structure and give plausible hypotheses on the reasons for such changes.

c) Network and hypermedia communications

Most of the initial preparation work before the visits to the museum can be based on hypermedia support and interactive exchange over the Internet. This includes most of the information, explanation and preparation phases of the teachers, as in particular, for: (i) selecting didactic itineraries and preparing visits for particular users, eg
schools, classes, environmental groups, nature club groups; (ii) preparing visits, plus carrying out the visits themselves, which as we have already mentioned, may be 'discoveries' for the teacher/group organiser; (iii) processing materials arising from the visit, such as producing reports, drawings (or in the case of extensions to middle and high schools), student to student interactive collaboration via the Internet.

This solution saves considerably on time and organising loads thanks to the computerised version. It also leads to greater autonomy, flexibility and operating efficiency both on the part of teachers and museum staff.

d) Main Body

This is the most important section since it supplies the main support for the didactic project as a whole. Schools can communicate with each other and exchange worksheets, images, comments, etc. Teachers can also file activities carried out by their students, which they can then consult, thus facilitating any assessment or quantification of such data.

➤ Student level

Bearing in mind the activities, the operating phases, and the worksheets outlined in Section 2b, we will now describe how the pupil activities were developed. Each piece of classwork is recorded in the database so that it can be looked at again at a later date.

1st animal list. The list is compiled via a field equipped with a scroll bar where the list can be written.

**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 (see Fig. 4) 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 (see Fig. 5) 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 (see Fig. 6). Pupils have to colour (using a colour palette) the skeleton parts using the same colours as in the complete skeleton.

**2nd animal list** This part shows three adjacent scrollable fields which are synchronized in their scrolling: (i) the first shows the list written by the pupil while carrying out the *1st animal list*; (ii) the second and the third are to fill in with information regarding 'what it eats' and 'where it lives', respectively.

**Cognitive worksheets.** There are three worksheets for each animal, each with photos (zoom option available). The first and third are easy for the pupil to fill in by writing their observations, the second is purely informative and is in text form. There are only a few 'verbal-written' components, while it is possible to show animations (sometimes in 3D) or a short film or photo in which there are hot points which the pupils can click on to get further information by text or audio comments.

**Composing skeleton.** The human skeleton (see Fig. 7) 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.

**Test worksheets.** There are five of these: (i) the first is filled in like the one for the formation of sets, but this time it is the names of animals that are dragged into the right sets, they only become icons during dragging; (ii) in the second the pupil clicks on dedicated buttons to choose the characteristics indicated, and on the other side, writes observations on the dedicated lines; (iii) the third presents pictures of two skeletons, the pupil has to identify the mammal and give relevant explanations; (iv) in the fourth the pupil collocates some mammals according to their habitat in some Carroll diagrams. This is carried out in exactly the same way as in the first worksheet; (v) in the fifth there are three scrollable fields: in the first pupils can select one from a list of names of animals corresponding to those chosen and/or added by the teacher during authoring (see below). In the second changes in the structure of the animal are written and in the third the related reasons.
Teacher-only activities

Teachers can choose from:

Customizing. Teachers can store and update personal data on their students, plus data identifying the class (head of school, name of school, name of class). The application can be adapted to specific didactic needs - teachers can choose which games their pupils will play, which animals to study etc.

Below are some details on the various options the teacher has available.

Insert classes and pupils. The data described above (district and name of school, name of class) can be inserted, along with pointers to four tables that are created to contain data on the activities carried out by pupils in a particular class.

Change class and pupils. Teachers can delete the class, delete the school that the class belongs to, modify data regarding the class. Once the changes have been confirmed they are then transferred to the tables for the class in question.

Choose animals. This enables teachers to choose some of the animals or to create new worksheets for other animals, or to import worksheets from other schools.

Choose game. Teachers can choose the games by clicking on the name of the required game, among the many games offered.

Change password. Teachers can change the password for entry into the application (ie the one for pupils) and/or the teacher's one.

See classwork. Teachers can see the results of student activities. Four scrollable fields are shown for teachers to inspect - pupil name, class, school and district. The page of the activity chosen is then displayed with all the data on the work carried out by the pupil selected. Teachers can then print the result and take notes on the reports on each student, on a page which shows a dedicated 'notebook'.

Tests. Teachers can put themselves to the test, using the same paths as their pupils and encountering the same difficulties.

e) Support Sections

Tutorial The Tutorial is a "user manual" that illustrates the project step by step with guidance on how to use the hypermedia tools; to make explanations as clear as possible it is equipped with images, animations, sounds, and most important, hypertextual links. The animations regard above all explanations of some pupil activities, and give a much better idea of how activities should be carried out than would have been possible with written text. The sounds are used for special effects during the animations and as background music.

Teachers can click on a hotword to get hypertextual links, and audio-visual support by clicking on parts of the text or images contained therein. At any moment teachers can visualize a map which shows them what they have already read (even if not in sequential order), where they are up to in the general map, and where they can re-enter.

Worksheet Collection This section is for collecting data on how the itinerary is going. Verification can be directed to both children and teachers:

1) children - directly on the their level of learning, via the completion of worksheets that establish the base knowledge on certain subjects (initial test) and then the worksheets relating to the contents and methodologies adopted during the execution of this didactic unit (final test);

2) teachers - via a questionnaire which finds out the level of satisfaction with the project, with some notes on changes that could be made to make the project itself more functional, with discussion and comparison of any modifications/customizations made in class.
General remarks

The proposed approach facilitates, more than in the past, the contact and integration between:
- aspects of different disciplinary pertinence,
- extra mural activities carried out with the support of 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
3) encourage teachers in a more active and collaborative way to participate in carrying out their role as educators.

To further illustrate the potential of the various forms of ‘integration’ that we have highlighted, we would like to focus on just another one of the many examples, concerning the environmental, industrial and technological heritage. Besides developing autonomy in the pupils, there is a healthy mix of the following notions and experiences:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Direct and in ‘context’ Experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Sciences</td>
<td>Examples of flora and fauna in their natural habitats</td>
</tr>
<tr>
<td>History and Humanities</td>
<td>Traces of archaeological, anthropological, cultural and local materials (mountain areas)</td>
</tr>
<tr>
<td>Geography</td>
<td>Astronomic and climatic conditions (development of self-reference and orientation skills)</td>
</tr>
<tr>
<td>Technological Aspects</td>
<td>Current and/or past mining techniques, Workmanship on minerals (e.g. metals, irons), Management and use of water resources as a potential / current source of energy, Production of hydroelectric power</td>
</tr>
</tbody>
</table>

If this is well organized, pupils will have the opportunity to acquire directly and in context fundamental aspects of reality and to exploit them as a basis on which to enhance, elaborate and interpret notions from the classroom, by the ‘transmission’ and processing of the ‘abstract’ data from intramural teaching.

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 potentials, experiences and didactic approaches.

Conclusions

We have presented and discussed the rationale behind some recent experiences in exploiting the cultural heritage for enhancement and integration with traditional didactic activities carried out in schools. This approach is based
on Hypermedia, Data Base and Network Communications. These technologies allow museums to produce, and schools to use, didactic itineraries aimed at integrating the extramural activities offered by museums with those activities offered within a school. We have discussed the main organizational aspects along with the roles of those people involved, and shown how they can help develop pupils’ creativity, larger mental outlook and awareness.

This approach could be extended to the environmental heritage, eg natural parks, or other environmental/cultural institutions.

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