1. Hypermedia and Education

We are living at a time when new learning systems based on the use of the computer are being created (micro-worlds, simulations, hypertexts); these systems aim to encourage the learner to build up his own knowledge.

These systems are defined as «flexible personalized information tools» [Kommers Jonassen Mayes 1992], and many writers underscore the possibilities offered in supporting self-learning and the involvement of the students in meaningful cognitive information processing. Hypertexts in particular and, more generally, hypermedia, appear to open up great educational possibilities in complex, multi-disciplinary areas.

It is well-known that through a non-linear presentation of information, which is the main feature of hypermedia, it is possible to highlight the existing relationships between various concepts. Moreover, the possibility of offering a large amount of information material (texts, images, diagrams, animation, audio and video recordings) and making them easily accessible to the student, in different language and media types, will provoke and satisfy the learner's curiosity and encourage further personal research.

Hypertext is commonly defined as non-linear text, in which the content is organized in basic units of information called «nodes». The interrelationships between these nodes of information are defined by links. Links can define an associative relationship between the nodes that they connect, or can provide organizational information. Links are usually activated by positioning the cursor on a «hot button» on the screen and clicking the mouse to move to the related node.

Hypertext is also defined as «virtual text» [Fischer Mandl 1990] [Antinucci 1991], because the learner decides which parts and how much of this «virtual text» he wants to see. The outcome will be different for each learner and for each studying session.

A hypertext document is therefore made up of nodes and of inter-
connecting links, which go to form a more or less complex network of information and relations. In addition to connecting nodes, the links provide information on the existing relations between nodes: subordinate, dominant, associative relations, etc. A hypertext may therefore be defined as an integrated knowledge base in which not only concepts but also the logical relations between concepts are supplied.

Recent research into hypertext in education emphasizes three important characteristics of this tool: broad access, high level of user control and support for cooperation [Marchionini 1988]. A hypertext application is able to store a large body of information which can then be presented in more than one manner. Access to the information is facilitated by the associative organization and curiosity or the need for further information can easily be satisfied by activating links with a mouse click.

The use of this technology seems to be particularly helpful in a complex knowledge domain as it makes students aware, not only of new topics, but also of links and associations existing between concepts. The network of existing relationships in a complex domain can become clear to the student as he or she navigates through a hypertext application.

Hypertext is considered a cognitive tool in so much as it engages learners in an intellectual process [Kommers Jonassen Mayes 1992]. When learners navigate through a hypertext application, they must make decisions about what to see and where to go. This means greater involvement in the material, and learning is usually more effective when learners think actively about the material.

Although the amount of theory on the use of hypermedia in education has built up, there are actually few multimedia tools specially designed for educational ends and even less experimental research on their effectiveness in terms of knowledge acquisition. With the construction and experimentation of the hypermedia application ‘Ecoland’, the aim has been to make a contribution towards an analysis of the opportunities offered by these new tools for building new knowledge and skills.

2. ECO LAND

Ecoland currently runs on MS-DOS workstations, using Toolbook, a hypertext development program.

The application is aimed at students of twelve to fifteen years of age and asks them to analyze three different waste treatment solutions.

The students are required to explore an environment in order to collect
as much information as they can about the consequences of the proposed solutions. They take on the roles of experts who are assigned with the writing of a report that will help the mayors of the three towns to make a decision.

Information is organized using a spatial metaphor:

The region contains three small towns, each of which represents a single environmental education topic: the dangers of air pollution, problems arising from water pollution and the importance of forest protection (see Fig. 1).

*Fig. 1*

_The region of Ecoland, with the three small towns_

In each town, students can enter four different places in order to gather information at different levels of depth and complexity. They can visit the _town hall_, the _library_, the town’s _archives_ and the _main square_ of the town (see Fig. 2).

In the town hall, one can find out about the town’s economy, population, natural resources and the amount of waste which is produced in each town.

In the library, the user can consult books which provide scientific information on how to deal with waste and issues concerning air, water and forest protection. The information provided by the books is presented in hypertext form, with both referential and organizational links: students can
Fig. 2
The main square of Acquaforite. We can visit the library, the townhall, the town's archive. We can also meet people and listen to their opinions.

Fig. 3a
open cards containing more detailed information and explore the relationships between nodes of information (see Figg. 3a and 3b).

The archives contain information on laws and back issues of newspapers as well as information on the decision-making bodies and associations which deal with the problems at hand.

It is also possible to meet people in the main square and listen to their opinions.

Students can use different tools (a note book, a dictionary and a telephone) to communicate with economic and environmental experts. These tools can be recalled or hidden by clicking on different icons.

3. Educational and Cognitive Range

Ecoland is an activity which can be used as a group project by an entire class. Students are required to analyze and solve a problem concerning waste treatment. Different solutions must then be discussed by the whole class, with the aim of presenting the mayors of Ecoland’s three towns with a well thought out solution.
Ecoland presents a hypermedia learning environment based on information retrieval and the discovery of relationships. The students must find the information in Ecoland with which to carry out their assignment by exploring its various environments and learning about the environmental and economic resources of the region, listening to the opinion of its inhabitants, reading books and looking up laws. In this way, the students will come to realize the complexity of the interrelations which can be found in a single region.

Ecoland simulates an imaginary and yet realistic environment in which students encounter real-life problems. Students are encouraged to see the connections both between the things they learn and how they are presented in this activity and in the world around them. The way in which the information is organized in Ecoland can help students to understand how to go about an investigation of this sort and what types of data it will be necessary to collect.

Students are guided in their exploration and search for information by an expert on environmental problems. A short time after arriving in Ecoland, they receive a phone call from the expert, who introduces himself and provides some useful advice on how to organize the survey they have been assigned. The expert follows the students throughout, indicating the steps to be performed as they come to them. The youngsters can get in touch with him via the «telephone» whenever they deem it necessary; they may telephone to reread the advice he gave them or to know how to proceed once they have completed a phase of their work. The figure of the expert has been created to give students not only the possibility of widening their knowledge on the chosen topics but also of learning about research methods, of being able to organize and plan the various phases of a personal research.

When a research is carried out to establish the damage or advantages an action might bring about on a region, the first thing to do is to see how the region is made up, finding out about its geographical, economic and environmental features. One must have a background knowledge to solve a problem: it is necessary to go to the library to collect useful information in order to be able to solve the problem of treating and disposing of waste; moreover, in order to provide the Mayors with an assessment of the three proposed solutions, it must be verified that these solutions comply with the laws in force in our country, and then analyze in detail the pros and cons of each solution from an environmental viewpoint, with special emphasis on the protection of people's health, and from an economic perspective.

Another figure used to guide the students in their work is a «travelling
companion»: a girl from an Ecoland school called Ilda, who has attended a course held by the environmental expert and who accompanies the youngsters as they explore the Ecoland territory.

The idea of a travelling companion is both a practical aid (what it is possible to do now) but more especially an aid to the methodology adopted. She suggests to students what information to look for in a certain place, highlighting problems and underscoring the existing relations with other information stored in other parts of the territory; she also summarizes the essential points of the texts being read by the students, and invites them to take notes so as to be able to back up the advice given to the Mayors in their report with reasoned motives.

The organization of the navigational system in Ecoland is mainly hierarchical (see Fig. 4).

**Fig. 4**

*How information is organized*

![Diagram of Ecoland's hierarchical navigation system](image)

In order to help students understand the complex relationships existing between the different parts of the knowledge domain, however, Ecoland was given a mixed structure. Although a hierarchical structure tends to make navigation easier, it can also result in the representation of knowledge by the hypertext application being extremely simple and rigid. Ecoland's structure combines the simplicity of organization offered by a hierarchical structure, and the additional possibilities provided by the use of referential links. Referential links allow for a complex representation of knowledge by
pointing out the existence of relationships between two different parts of the knowledge domain.

The domain of knowledge presented in Ecoland draws particular benefits from its hypertext organization. Complex material is presented, in which various different concepts and types of information co-exist, including geographic conditions, economic data, laws, the opinions of the inhabitants and other scientific information. All of these must be understood and integrated in order to accomplish the task. The same information can be gathered at different levels of complexity. For example, the mayor’s speech and the technical report supply almost the same information, but use different languages, the first being presented in a colloquial style while the second uses technical, bureaucratic language.

Further, the referential links used by Ecoland make it possible to stress existing relationships between problems related to environmental education. Such links, for example, make clear existing relations between each town and the overall environment (if the water used by the farming town is polluted, the entire region will suffer the consequences) as well as possible connections with global issues (water shortage and pollution, the greenhouse effect, deforestation etc.).

Ecoland is designed to be used as an introduction to environmental issues, and to encourage further research into questions specific to the region in which the particular group of students live. Students are invited to carry out on-the-field surveys and organize gathered data in an «empty container» (a software programme called «my city»), which provides the same spatial organization as that in Ecoland: a region in which a town or city can be placed, which has a library, town archives and a town hall. Students are then invited to describe the features of this territory and organize the presentation of available information by storing it in the town hall, in the town’s archives or in specially compiled books to be kept in the library.

Ecoland therefore proposes a didactic path based on problem-solving activities and information searches, on group discussions of the appropriateness of various methodologies, on an authentic research in the local area and finally on an attempt to summarize and organize the information gathered and new knowledge gained. Such a path aims to achieve several objectives:

- To provide students with knowledge on the topics of waste disposal and environmental protection;
- To encourage students to be aware of the existing relations between different sorts of information;
• To make students aware of the complexity of relations formed in a domain;
• To suggest a research method;
• To encourage students to carry out local research.

The study of one’s own environment is universally considered as the most important phase of environmental education; exploration of the territory of Ecoland sets out to make the initial impact with the problem and then to encourage exploration of the environment in which students actually live.

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