New Trends for Continuous Training in Small and Medium Enterprises

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A project, called Qualification 2000, supported by the EC's Adapt initiative has been developed. The project focuses on the use of multimedia and net-based educational tools for continuous training in informatics and its applications in office automation.

In this paper, we shall discuss the main lines of the project, focusing on the method we adopted in order to transfer research results on computer based training to small-medium enterprises (SMEs).

In particular, we shall focus on the analysis of needs we performed, and on the results we obtained from the cases studied. Then we will analyse the influence of these results on course design, through five prototypes. This analysis aims to make a constructive contribution to the discussion on how to render computer based systems an effective tool for training in SMEs.

Keywords: technology transfer, distance learning, educational multimedia, human computer interaction

Introduction

The design of efficient methods to develop continuous training systems is a theme of considerable interest, from the socio-economic point of view (European Commission 1995a, 1995b). In fact, the continuous evolution of the job world, as to both methods and tools of production and organisation, requires people to renew continuously their cultural and technical background and to deal with changes showing mental flexibility and positive attitude. Multimedia and net-based systems offer new perspectives to the solution of this problem, as they constitute a powerful tool to realise self-learning, distance learning with the teacher's guide, and distance co-operative learning. The numerous experiences in the field point out the educational potential of this approach, as to both the possibility of increasing the resources at students' disposal and the possibility of developing educational processes which correspond to individual needs (Blandow & Dyrenfurth 1994, Kaye 1991, Verdejo & Davies 1997, Wild 1996).

These experiences are mainly carried out by large organisations or universities, that is in the research and technologically advanced world (D'Halluin et al. 1996, Fulmer 1996, Neild 1997, The Open University 1996). The situation is completely different as to small and medium sized enterprises (SMEs), notwithstanding their central role in our economy. Consequently, as it has been already noted (European Commission 1993), it seems worthwhile to analyse how to transfer research results on computer based training to these kinds of companies.

This technology transfer problem may prove difficult for several reasons, the most important being the diversity of these companies, their economic situation and the limited number of opportunities of collaboration between small and medium enterprises (SMEs) and the research world. Our work follows this line. In particular, we are developing a project, called Qualification 2000, supported by the EC's Adapt initiative (Forcheri et al. 1997). The project focuses on the use of multimedia and net-based educational tools for continuous training in informatics and its applications in office automation. The target is women employed in small-medium enterprises who face redundancy.

In this paper, we shall discuss the main lines of the project, focusing on the method we adopted in order to realise an effective technology transfer process. In particular, we shall focus on the

analysis of needs we performed, and on the results we obtained from the cases studied. Then we will analyse the influence of these results on course design, through five prototypes. This analysis aims to make a constructive contribution to the discussion on how to render computer based systems an effective tool for training in SMEs.

Overall organisation of the project

Generally speaking, the technology transfer process consists of moving a new idea from the source to the users. The concept of a new idea is often originated in the research world: the idea is discussed in depth, and all efforts are devoted to analyse its feasibility from a technological point of view and the novelty of the proposal with respect of the state of art in the field. When the idea is validated from the point of view of research, the technology transfer process starts. As it is well known, this is a very delicate problem. In fact, the successful accomplishment of this process requires researchers and users to share a common view of the technology, taking into account both potential advantages of the innovation and operative problems, that is support processes, distribution channels, users needs and perceptions, economic aspects, maintenance, etc., it requires to face. The lack of such common view is one of the main causes of the fact that only a very limited number of good research products becomes innovation.

Taking into account these problems and present work on technology transfer (Zelkowitz 1996), in the project Qualification 2000 we propose a working line that integrates three approaches called co-operative, prototype and forum respectively. Let us briefly discuss them.

1. *Co-operative approach.* Under this term we mean the establishment of a work-team comprising researchers and representatives of enterprises. This team activates a negotiation process that, taking into account the experience of researchers and the users' problems, works out a proposal feasible and aligned with the real world. In fact, this kind of co-operation helps to build a solid relationship between those offering the technology and those accepting it, and to integrate different perspectives on the proposal, thus guaranteeing usability in a real context of a technologically advanced production (AAVV 1996b).
2. *Prototype approach.* Under this term we mean that researchers periodically give informal demonstrations of the prototypes representing the application of the proposal. This approach offers users the opportunity to see new work that could turn into viable products. They, in turn, have the opportunity to give inputs to the researchers about future directions of different aspects of the suggested ideas.
3. *Forum approach.* This means to present the proposal to a wide audience of users, to introduce them to the theme, to involve them into the problem, to raise discussions aimed to adapt the proposal to the context of use as much as possible.

According to the working line described above, the project is organised in five phases (analysis of the application conditions, test of feasibility, validation, refinement, dissemination) and comprises different types of activities: analysis of training needs, design and realisation of prototype CBT courses, testing of the prototypes, revision, implementation and delivery. Let us analyse these activities.

1. *Analysis of training needs.* A general exam of our proposal, carried out by the working team, constituted the starting point of the need analysis. This exam highlighted some peculiarities of the users, in particular the low level of informatization and the limited opportunity of investing time and money for training. However, the discussion clarified the need of going more in depth in the analysis of training problems in SMEs, from the point of view of both the enterprise and its employees. As to the enterprise, we had to gather information about the content to be learnt and the skills to be acquired by the employees via training. As to the employees, we intended to carry out a cognitive analysis of their learning difficulties, personal problems and attitude towards office automation and training in its use. The team examined various methods to analyse the training needs; at the end, it was decided to interview a representative sample of SMEs. The results of the interviews will be analysed in the next section. Here we would like to observe

that the presence of persons with different backgrounds and interests in the team was fundamental in this phase of the work. On one hand, personnel of SMEs greatly contributed to define the sample and to structure the interviews adequately; on the other hand, researchers mainly defined the technological and educational technology part of the interviews.

2. *Design and realisation of prototype CBT courses.* This focus on content organisation, the design of the user interface, the use of metaphor, user requirements, the user friendliness and technological constraints. The design and realisation of the prototypes is a joint effort of IMA-CNR researchers and representatives of Italian enterprises participating in the project. Researchers designed, from both the pedagogical and technical point of view, the prototypes, and gave informal demonstration of the realisation in periodical meetings of the working team. The feedback from the working team enabled researchers to modify the prototype according to the needs of SMEs.
3. *Testing of the prototypes.* Consensus, verified via the collaborative design of the prototype, is not enough, in our case, to guarantee adequacy of the proposal, as final user of the product is the secretarial staff. Thus, a test with the final users was designed, in collaboration with a number of enterprises, external to the team. These enterprises gave us the opportunity to experiment the prototypes with some of their employees. 24 people, mainly women take part in this work, which is currently underway. A team of researchers is supervising the activity of the user-experimenters in order to evaluate the acceptance of the prototypes.
4. *Revision of the prototypes.* According to the result of the experiment, an acceptable version will be produced. Moreover, the context of use will be defined precisely, support material and a guide for use will be written.
5. *Implementation and delivery of the system.* We intend to organise workshops devoted to SMEs, in particular to training managers, and to put the material on the Internet.

Table 1 summarises the overall organisation of the project, relating both activities and corresponding approaches to various phases.

The first two phases have already been completed, while the third one is currently underway. In the following sections, we shall describe the result of the analysis of training needs and the approach we followed in the development of the prototype according with this analysis.

Analysis training needs

We designed two structured questionnaires, directed to management and secretarial staff of SMEs respectively.

The management questionnaire was divided into three parts. Part one covered general information about the enterprise (size, main activity, work organisation, changes planned, etc.); part two the level of automation (hardware, software, network, changes in the work due to automation, etc.); and part three training problems and experience in informatics (kind of training

PHASE	ACTIVITY	APPROACH
Analysis of the application conditions	Analysis of training needs	Co-operative approach
Test of feasibility	Development and realisation of prototypes	Prototype approach
Validation	Testing of prototypes	Co-operative approach Prototype approach
Refinement	Revision of prototypes and support material	Co-operative approach
Dissemination	Organisation of workshop and Web sites	Forum approach

Table 1. Overall organisation of the project Qualification 2000

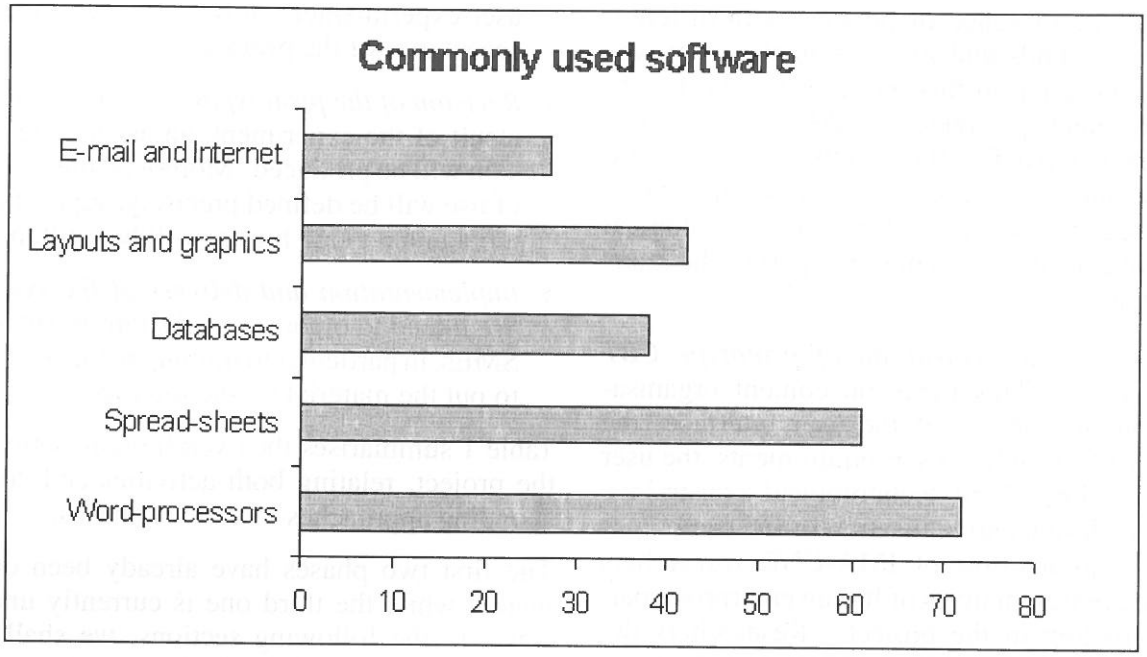

Fig. 1. Interviews to SMs — Commonly used software

organised, results obtained, suggestions for future training, expectations, practical and technical difficulties, etc.).

The questionnaire devoted to the secretarial staff was divided into four parts. Part one covered personal information (age, sex, kind of duties, work, experiences, academic qualifications, etc.); part two the level of knowledge on informatics (kind of knowledge, degree of self-confidence, ways of acquiring knowledge); part three opinions and attitudes towards informatics (changes, positive or negative effects on the tasks carried out, technical and cognitive difficulties arising from the use of informatics, etc.); and part four experiences of training and related problems.

The questionnaires were used as a basis for carrying out a series of interviews, an approach which is motivated by the fact that direct contact with people is fundamental for understanding their opinions and difficulties and identifying their needs. Each interview lasted for about two and a half hours. We interviewed a representative sample of SMEs working in Liguria, a region in the north-west of Italy.

From the interviews of the management we derived that the majority of enterprises were automated but the level of automation depended on the company's size and kind of activity. In particular, we observed that neither local nor external networks were commonly used even in sectors, such as foreign trade where they can give a notable impulse. As to software for office automation, almost all enterprises use word processing and spreadsheets, while the use of databases is quite limited (see Figure 1). Almost all enterprises had tried out some kind of training on automation, mainly traditional courses and tutoring (see Figure 2). The use of CBT is almost absent.

For the secretarial questionnaire we interviewed: skilled and unskilled computer users, people acquainted with different type of organisation work (from strictly hierarchical to the one organised by function), and with different duties and levels of responsibility.

We observed a generally positive attitude towards automation, especially among younger employees and those in very small companies. However, the interviewees seemed to be worried about the risk of not being able to cope with the computer, being measured against other employees and losing autonomy. Moreover, we noted that almost everyone was aware of the need of training in automation, but there was doubt about whether the kind of training activity undertaken would actually help to introduce qualitative automation in enterprises. This scepticism was mainly the result of previous training activities. From a psychological point

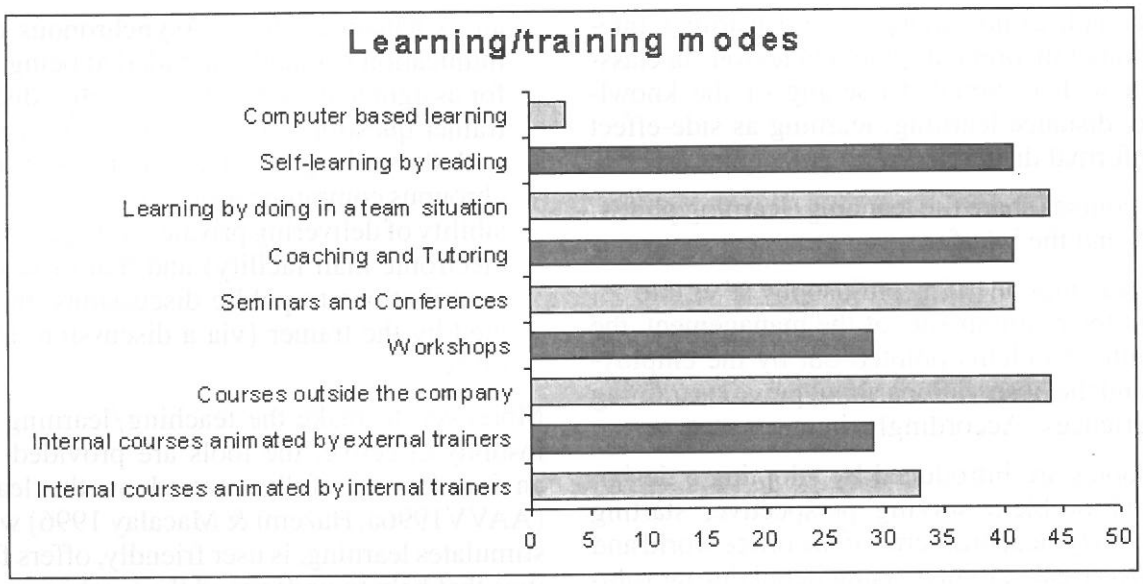

Fig. 2. Interviews to SMs — Training methods (percentage of use)

of view, the following difficulties were pointed out: fear of losing one's reputation with colleagues and subordinates; and the gap between learning needs and the teaching approach to the content. Finally, the need to devote their leisure time to study and exercises, and the problem of being loaded down with work during the training period contributed to a dubious attitude towards training.

Considering the above, we think it is necessary to provide enterprises with training in office automation to:

1. Explore typical working tasks and decide what type of software tools, if any, can increase the quality of the job;
2. Investigate if and how the use of computers can favour the introduction of organisation methods not adopted in the enterprises, but able to improve competitiveness;
3. Critically analyse the technology to define how useful it can be in a specific work situation;
4. Recognise software tools as particular examples of general models;
5. Abstract the general features of a software tool in order to acquire the capability of passing without difficulties from one tool to another of the same class;
6. Consider the computer network in a practical sense as a means of interacting with colleagues in a more collaborative way.

A training course is not enough to pursue the above mentioned objectives which can only be reached by a process of continuous learning. However, a training initiative can be devised in such a way as to guide the participants towards attaining them. Therefore, we bore them carefully in mind in the design of the prototypes.

Design of the prototypes

We developed five multimedia prototypes, endowed with the possibility of communicating with outside (the teacher- consultant and other colleagues). The courses regard: Graphic User Interface (GUI) operating systems, text processing systems, spreadsheets and numeric data management, databases, electronic mail. The course topics were chosen to meet a dual need: a) to give participants the kind of general knowledge that will help them gain awareness of technological evolution and its impact on the socio-economic situation; and b) to provide tools and practical knowledge that allow participants to integrate new skills with those already mastered, so that they become able to manage transformation in the workplace brought about by the introduction of advanced information technology. According to the needs that emerged from the interviews, the courses are meant to encourage

different learning strategies: self-learning, integration of theoretical/practical lessons in classroom with personal deepening of the knowledge, distance learning, learning as side-effect of informal discussion with colleagues.

The courses share the teaching/learning philosophy and the interface.

The teaching/learning philosophy takes into account the requirements of the management, the learning problems pointed out by the employees and the observations about previous training experiences. Accordingly, in our prototypes:

- Topics are introduced by adopting a design and problem solving perspective, starting from typical problems of the office world and investigated in increasing detail during solution of the problem itself: as far as possible, this is done independently of a particular application software. Specific applications are presented as operative examples of a class of tools and relevance is given to the strategic and decision aspects of job procedures.
- For each topic, the user is provided with an explanation, a demonstration which shows how to deal with the situation at hand, and a set of activities in group and individual exercises. The exercises are mainly meant to be used for self- evaluation and can be solved with or without guidance. Feedback is provided after each problem is solved.
- A simulation system is provided for observing demonstrations and for practice. In our opinion, this is more effective than an actual software system, because the simulation system is under the control of the training system.
- The user is provided with the possibility of keeping in touch with other colleagues for help and collaboration, with the teacher/consultant for private communications and with the teacher and the other colleagues for public discussions. This possibility is realised by means of a synchronous conversation module, which allows interaction among many persons online at the same time, and of an asynchronous communication module, which allows to deliver private and public e-mail. Synchronous conversation is used to encourage learners to be co-operative during consultation of a course (to discuss about a specific point, to solve an exercise, to ask for an explanation, etc.). Asynchronous communication is mainly intended at being used for assignment feedback, to ask the (distant) trainer questions, to take part in discussions with the colleagues, etc. Accordingly, asynchronous communication comprises the possibility of delivering private messages (via an electronic mail facility) and that of sending contributions to public discussions, moderated by the trainer (via a discussion list facility).

Moreover, to make the teaching/learning philosophy effective, the tools are provided with an interface carefully centred on the learner (AAVV1996a, Hazemi & Macalay 1996) which stimulates learning, is user friendly, offers facilities that help to understand the teaching model proposed, uses metaphors taken from the working context, provides feedback, and proposes activities carefully structured to focus users' attention on the contents they have to learn. In particular:

- To encourage the users who are not computer experts to become familiar with the machine, the interface is very simple. Its elements are very few, all of them are self-explanatory. The instructions for use can be accessed at any moment by pressing a corresponding button (individuated by the symbol ≪?≫) and are contained in a single screen. Each screen is divided into three parts: the working space, the bar of the buttons for navigation and communication with the outside, and the bar of topic buttons (see Figure 3). To proceed through the course and access the various possibilities the user only has to push buttons and ≪hot≫ words. Each operation is performed by pressing the corresponding button. The buttons evoke their meaning: some are represented in an iconic form, while others feature the name of the operation. ≪Hot≫ words are identified by their colour. When the mouse cursor is over an active zone (button or ≪hot word≫), its shape changes; moreover, a textual description of the meaning of the active zone is shown in the top-right corner of the screen.
- The interface has been structured in a way that helps users understand the teaching/learning model embedded in the system. At all times the user is given the possibility of communicating with the outside or going on with

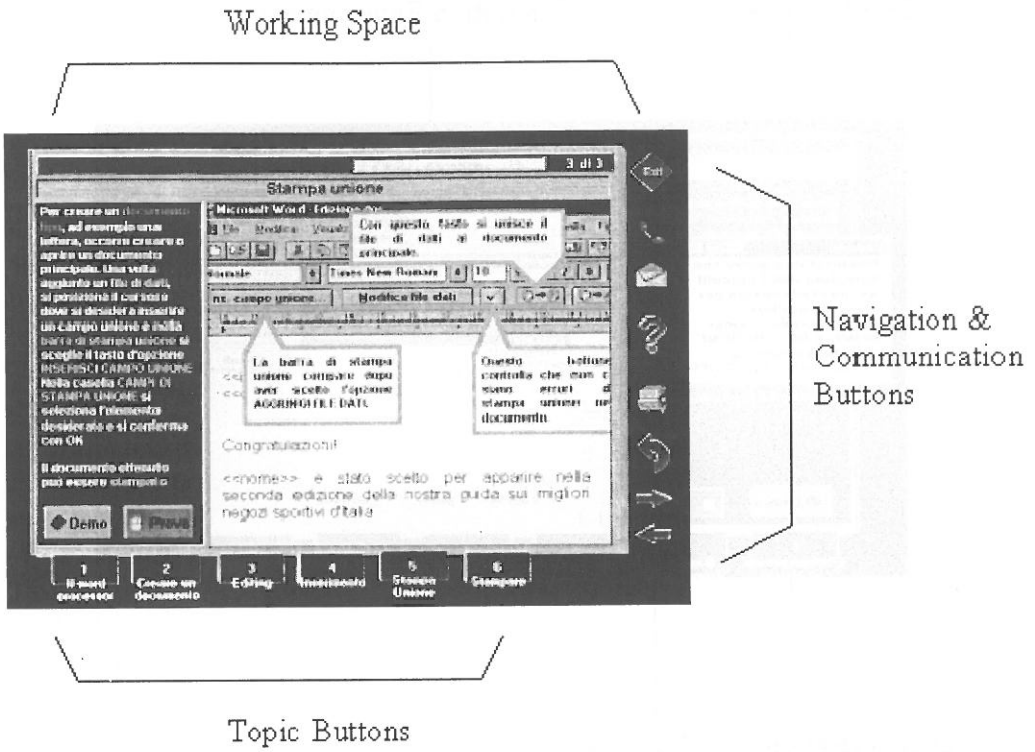

Fig. 3. The organisation of the screen

the course: this fosters a flexible approach to learning and encourages the user to seek assistance from the teacher and collaborate with the colleagues. The working space, which is meant to be used for self-learning, is organised so that three strategies are available: learning by being taught, learning by observing and learning by doing. It is divided into two parts: the *lesson space*, and the *simulation environment* (see Figure 4). The *lesson space* always contains a brief explanation, and two buttons, named DEMO and PRACTICE, one of which displays a demonstration and the other one the text of an exercise. The *simulation environment* is used to show the demonstrations and to carry out the exercises.

- To help the user feel self-confident and encourage him/her to show initiative, he/she can choose between solving each exercise on his/her own or under the guidance of the system. Moreover, demonstrations and exercises are always offered as possibilities, but are not compulsory.
- To avoid frustrating situations, both problem domain and control domain feedback are provided.
- To allow consistency in look and feel, each screen contains the same number of buttons, always in the same positions. Different colours always code different information. For example, DEMO and PRACTICE buttons in the lesson space are in different colours. Sections of text which represent links to other parts of the course are shown in red, while those that open pop-up windows are represented in black.
- Given their background, users are probably more familiar with card-indexes than books, so the material is organised according to a card-index metaphor: each course is presented as a card-index; the material is organised in folders, each one corresponding to a topic; and the subtopics are presented on cards.
- To help the user feel in control of the material, the card-index is always present at the bottom of the screen. The index is constituted by a series of named buttons, each one representing a folder with the corresponding title. The button corresponding to the selected folder is highlighted. Moreover, a

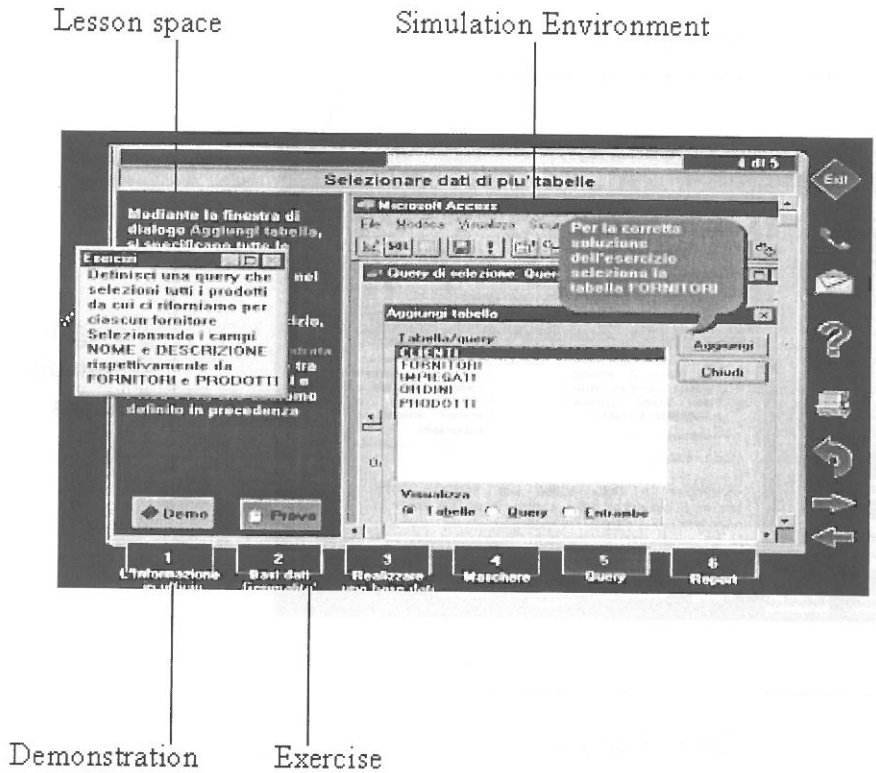

Fig. 4. The structure of the working space

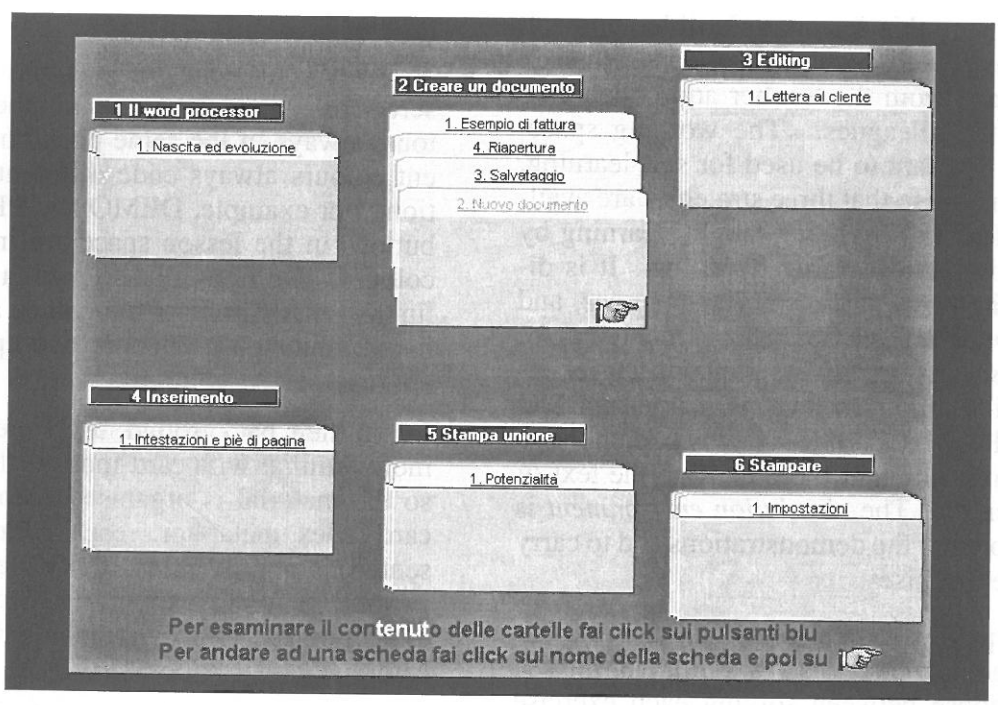

Fig. 5. The detailed index of the package Word Processors

button on the right side of the screen displays a more detailed index (folders and cards). Pressing on the corresponding name, the user can directly access the card desired (see Figures 5). Finally, to give the user feed-back on the path followed in navigating through the material, the cards already visited are indicated with a different colour.

- The user navigates in the hypertext using standard information search methods: he/she can move on to the next card in the folder by pressing a forward arrow, or return to the previous card in the sequence by pressing a back arrow.
- The communication buttons feature icons which clearly identify the kind of communication (synchronous or a synchronous).

Conclusions

Multimedia systems endowed with the capability of communicating with the outside, seem to have the potential to give impulse to training in small and medium enterprises. Careful design of the interface is particularly important to make these kinds of tools productive (Bekker 1996, Nordby 1995). As it has been already noted (Klein et al. 1997), a task listing is not sufficient usually for guidance in Human Computer Interface (HCI) design. A user-centered design approach is needed to identify the needs of the user and make the system conform to these needs.

The prototypes constituted an attempt to put into practice the guidelines resulting from interviews with potential users. The validation of the approach is carried out in two steps: during the development, through informal discussions and meetings with representatives of the enterprises involved in the project; after completion of the prototypes, through experimentation with a sample of employees. Involvement of the enterprises in the prototype development phase is for us a real opportunity to orient research towards innovation and to make proposals which gear research ideas to actual needs.

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