The methodology for the design and implementation of multimedia systems training in the firm

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Abstract
Multimedia Tutoring Systems are aimed to integrate all communication forms using multimedia supports (image, voice, text, ...). Designers of tutoring systems based on new communication technologies are faced to the following basic problems: i) integration and reusability of multimedia documents and ii) learning processes control using unstructured and not deterministic procedures. The authors are attached to underline the contribution of object-oriented development tools and methods for creating and maintaining multimedia tutorial environments.

1 Introduction
The proliferation and development of data processing in firms takes leaders of these companies to ask them about the origin and the use of these information resources. From a way purely technological (How to use the computer?), we can progressively analyse the development of the Organisation (How to manage problems of information and training in firms?).

These worries were accompanied by a semantic transformation: <data processing> that changed to <data processing of Organisation and management>, then appeared <information systems> and today we have <multimedia systems>.

In this moment we can ask: For what proposal we have 'multimedia systems'? What means these words? How multimedia systems are important in firms? In what these systems can help in our training systems? How to develop a research in this area? Is it really necessary to create multimedia information systems?

It's obvious to say that today Organisations depend on the quality of information systems and also on the efficiency of human resources that use them.

There are two different consequences of this in training system:
- This evolution offers new objectives and is part of the professional training. The evolution may contribute to prepare more and more people to the technological and Organisational changes. One great implication of these changes is the learning of these technologies by the new professionals and the conception of a technological culture.
Multimedia systems give a good contribution to the learning of all these information. P. Bordieu and F. Gros in "Technologies du travail intellectuel" consider this as "les capacités de communication", communication capacities.

- Training uses the information technologies and, as we can see it, is the main contributor to the organisational evolution. This contributes to an increase of the efficacy and the efficiency of the training, allowing for the training of more and more people. This corresponds with the structure of the training method.

This paper involves two research methods: (1) the communication of multimedia systems and (2) techniques of application and use of a methodology of conception and installation of information systems and use of multimedia to the management of the training in firms or colleges.

People that create systems based on this new communication technology can encounter two kinds of problems : integration and re-use of multimedia documents and the learning processes that are by nature, not structured and not determinist (N. Chomsky [7]). The objective of this paper is to show that methods and tools of object-oriented systems development turn possible the creation and evolution of multimedia pedagogical methods.

We show a prototype of one multimedia course. This prototype permits us to create a multimedia systems generator. In this work, we try to represent an object-oriented knowledge with the purpose of integration and reuse of these multimedia knowledge. It is necessary to give to the student only one way of absorption of the knowledge, and in this way he can't see any difference in the interaction of its use.

2 Documentary systems / Multimedia tutorials

From the point of view of data processing, a multimedia documentary system is a database that uses texts, graphics, sounds, static images, animation images and videos. They are organised in a structure that has information units called nodes. These units are linked in a way to build an access network that permits a non linear reading of the mass of information [19].

The meaning of multimedia or hypermedia was developed in 1945 by V. Bush [4] that elaborated a system that managed microfilms and instant photographic. This mechanism allowed users to access an enormous mass of information and allowed users to create 'associative indexes' capable to maintain a historic file to be accessed by the user.

But it was necessary to wait ten years of technological advances to see some results in hypermedia area. Currently the management of multimedia data is possible because of these technologies : (1) possibility to store a great quantity of data (CD-ROM), (2) video terminals that show high-resolution images, (3) possibility of recuperation of stereo quality sound and (4) high speed networks to transmit multimedia data.

Ever though integration of multimedia data was been achieved in some applications, interfaces between human being x machine are still a problem. To solve these problems, in one hand, there's a necessity to develop applications that create and edit these new kinds of data, and on the other hand, is necessary to specify how the sound and video could improve interfaces that actually exists.

"Multimedia data could help in the revision of models that use documents like they are used today" [5], where the principal interest is in the possibility of combination of different kinds of data in the same document.

Applications to edit this kind of document are very old. Applications may not be visible to the user and applications may be called according kinds of data that are used in documents. As a matter of fact one advantage of these tools is that they permit the encapsulation of numerous
applications that can be seen as an object. Soon it will be possible to enable and to disable these tools, accordingly the needs of the teacher or the student.

The next question is: how to use these multimedia data in the pedagogical environment?

3 Methodology for the design of multimedia systems

This methodology consists of:
- teaching pedagogy;
- resources that will be used;
- object oriented specification and development to help the creator of the system to do tests and to create their objects.

A multimedia system may be based on some well defined phases to create a product that satisfies different clients.

3.1 Phases

As we experimented various systems creators, the way that takes us to analyse the need [1] of a multimedia system "didacticiel" or didactic system is so far to be completely finished [8]. Only a modelling based on well defined phases will permit us to create a system that satisfies different clients. These phases are showed in figure 1.

![Figure 1- Phases of a process to create a multimedia system](image)

The working of the methodology that we are showing depends on a constant interchange of information between the parts that are involved in the project.

The methodology of the design of a multimedia course was defined using the object oriented method. We used the HOOD [14][15]method to the design and to creation courses. In the ergonomic part of the creation of courses, there are two important aspects: the first is the conceptual representation of data and treatments and the second, the external representation [1].
3.2 Pedagogic Structure

The methodology of a multimedia generator course that we will show, was developed by Ernst [9] and Luiz Lustosa [16] [18].

The methodological structure and the principles to represent the knowledge proposed by Christian Ernst were used to create a method of development, and the implementation was done in Lustosa doctorate thesis [19].

Using this methodology, we are proposing some multimedia intelligent pedagogic systems that are included in this paper [17] [20].

Any phase of the analysis uses three kinds of knowledge representation: identification of learning criterion, rules of learning criterion definition and definition of learning strategies, as we can see in table 1 in more detail.

3.3 The knowledge representation

Two aspects are considered in this method: (1) conceptual representation of data and treatments; and (2) external representation.

To represent data and treatments, after a detailed and well structured phase, there's the normalisation of the strategy, which puts in evidence the object structure.

Any phase of the knowledge representation uses three kinds of principles: textual representation, graphical representation and formal representation, as we can see in table 2 in more detail.

4 System generator

To build a tutorial (intelligent or not) we use three kinds of modelling: pedagogic, didactic and systematic of multimedia [18] [11].

Using an object oriented methodology, methods and tools applied to EAC must permit the specification of a primer model generator or an intelligent tutor.

4.1 An architecture

The supervisor is the intuitive program that permits the working of some activities not defined, allowing the interpretation of tasks done by the ADM user [17] [18]. Necessities (didactic categories to be produced) and hardware restrictions (kind of computers, multimedia hardwires) must permit the creation of an adequate ADM by the supervisor.

Generator architecture is composed by four main parts:

a) Student part or final didactic software, defines strategies to manage dialogues using general tools of response analysis, modelling of student knowledge and self-learning using results from these interactions;

b) Professor part that creates and updates the 'Objets Médiatiques' and the course structure. We can find in this part six functional units: six functions to create (sound treatment, image treatment, image recuperation, ergonomic study of colours, automatic study of the generation of screens and buttons (objects) and text integration) and six automatic functions to update the objects that are generalisation/specialisation of 'Object Médiatiques' class [16].

c) Tool box, that includes all requisites to model objects that will be used:
- multimedia systems objects, composed by multimedia objects (texts, graphics, sounds and images) and interfaces of the objects (buttons, windows, menus, etc.);

- task objects, implemented using procedures that manipulate multimedia systems objects;

This taxonomy takes us to create the generator tool box using two functional units:

- database called structures of models that specifies which tools can be used by all objects;

- Multimedia systems objects database, that includes multimedia objects and interface objects models. The tool box is managed by the supervisor, who is responsible for making an interrelation between multimedia system objects and task objects after their creation and update.

d) Supervisor, which is composed by a logical level that is responsible for the EAC, understanding the ADM user tasks. The tool box supervisor is created from the detailed specification of necessities (kind of didactic software) and hardware restrictions (kind of computer and multimedia technology).

We used as support the methodology of conception and help to the behaviour developed by Lustosa and Ernst [16] [18] [19] [10], permitting the supervisor to use these information at any time.

5 Conclusion

We collaborated in multimedia area with two complementary subjects: multimedia information systems and multimedia training systems. This project includes the conception of a multimedia training system and the development of a methodology of an object oriented multimedia system.

The study shows methods and tools of an object oriented development, permitting efficacious solutions to create and improve the multimedia pedagogic environment. The object oriented specification and design permit the integration and re-use of multimedia documents.

The conception and management of a database of documents is difficult. Firstly, because the importance of the information and then because of the great volume that multimedia data occupies.

This methodology is been used in a multimedia system at Santa Catarina University to create multimedia master of science courses.

6 Bibliography


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Table 1. Initial methodology

<table>
<thead>
<tr>
<th>Principle</th>
<th>Methods</th>
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</thead>
<tbody>
<tr>
<td>Identification of learning criterion</td>
<td>• Identification and measurement of knowledge;</td>
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<tr>
<td></td>
<td>• Building of thinking;</td>
</tr>
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<td></td>
<td>• Decomposition of a course in some problems;</td>
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<td></td>
<td>• Creation of the learning environment</td>
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<tr>
<td>Rules of learning criterion definition</td>
<td>• Modular representation of knowledge;</td>
</tr>
<tr>
<td></td>
<td>• Building of a thinking using past learning;</td>
</tr>
<tr>
<td></td>
<td>• Formulation of definition rules;</td>
</tr>
<tr>
<td></td>
<td>• Use of demonstrations absorption</td>
</tr>
<tr>
<td>Definition of learning strategies</td>
<td>• Mechanisms to control the thinking using:</td>
</tr>
<tr>
<td></td>
<td>• pedagogic strategies;</td>
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<tr>
<td></td>
<td>• pedagogic rules;</td>
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<tr>
<td></td>
<td>• dynamic order of knowledge.</td>
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<td></td>
<td>• Manipulation of knowledge using:</td>
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<tr>
<td></td>
<td>• thinking;</td>
</tr>
<tr>
<td></td>
<td>• objectives;</td>
</tr>
<tr>
<td></td>
<td>• pedagogic objectives.</td>
</tr>
<tr>
<td>Creation of courses</td>
<td>• We are proposing a method to create an object oriented multimedia course</td>
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Table 2. Knowledge representation

<table>
<thead>
<tr>
<th>Principle</th>
<th>Method</th>
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<tbody>
<tr>
<td>Textual representation</td>
<td>• Distinction between information (data, comments) and knowledge (criterion, rules and teaching strategies).</td>
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<tr>
<td>Language conventions:</td>
<td>• Validate knowledge learned with the creator:</td>
</tr>
<tr>
<td>• action;</td>
<td>• pertinence;</td>
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<tr>
<td>• explanation;</td>
<td>• fidelity;</td>
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<tr>
<td>• definition rules;</td>
<td>• pedagogic objectives;</td>
</tr>
<tr>
<td>• pedagogic rules.</td>
<td>• Do successive improvements of the knowledge:</td>
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<tr>
<td></td>
<td>• by generalisation;</td>
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<tr>
<td></td>
<td>• by distinction (or specialisation);</td>
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<tr>
<td></td>
<td>• build a RC model, based on classes, classes/proprieties and associations between these classes.</td>
</tr>
<tr>
<td>Graphical representation</td>
<td>• Implementation of courses using multimedia concepts:</td>
</tr>
<tr>
<td></td>
<td>• data;</td>
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<tr>
<td></td>
<td>• documents created using scanner;</td>
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<tr>
<td></td>
<td>• sounding messages.</td>
</tr>
<tr>
<td></td>
<td>• Implementation of models to represent knowledge;</td>
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<td>• Manipulation strategies.</td>
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