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► To cite this version:

Stéphane Crozat, Philippe Trigano, Olivier Hû. A knowledge base for evaluation and design of instructional multimedia software. OPODIS'99, Oct 1999, Hanoi, Vietnam. edutice-00000395

HAL Id: edutice-00000395

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Submitted on 10 Mar 2004

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A KNOWLEDGE BASE FOR EVALUATION AND DESIGN OF INSTRUCTIONAL MULTIMEDIA SOFTWARE

STÉPHANE CROZAT, PHILIPPE TRIGANO, OLIVIER HU

ABSTRACT. Authors and users of multimedia educational software are in front of the lack of experience in this recent field. Our works are oriented toward the research of relevant literature that could help understanding what is the specificity of such software. We particularly focus on finding criteria that describe satisfyingly the domain, exploring various areas, from usability to picture semantic, cinematography or text theories. The first part of this paper sums up our research along with the set of criteria we organised. We then applied and validated the knowledge we elaborated and structured, making tools to assist in evaluating and designing multimedia pedagogical software. The second part of the paper present our knowledge base and quickly describe some interfaces we built to exploit it.

Keywords: Education, Multimedia, Criteria, Evaluation, Design.

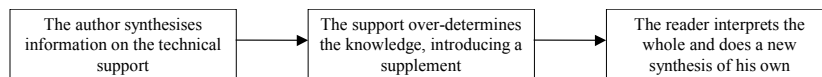
1. INTRODUCTION

Knowledge transfer takes an increasing place in our societies. Different ways of teaching appear, concerning more and more people, beginning earlier and earlier and ending later and later. We do need new tools to answer this new demand. Learning software could be particularly useful in case of distance learning, along-the-life learning, very heterogeneous skills in classes, children helping,... Our thesis is clearly not to pretend that learning software could replace teachers or schools. However, in specific cases, new supports are particularly advantageous, and can be integrated in the classical teaching process. Nevertheless, close to this new policy, we have to take into account that today's learning software are not so much used. There is no reason why this support should not find its role along with the books, the

traditional teaching methods in schools or firms. Thus we think that its relative failure is due to the poor quality of the current products, compared to what they could offer and what the public expects them to offer.

Two main problems can explain this gap. Authors do not know how to write multimedia documents and users do not know how to evaluate their relevancy. People are used to dealing with paper and textual documents. Nonetheless the valid principles for those documents are mostly not transposable to numeric and multimedia documents. The experience in the field of multimedia numeric documents is not wide enough, and we do not have equivalent rules to the ones that exist in the classical domain of edition. However our research intends to determine the bases of such rules.

Each technical support records information on a specific way so that it determines the way it will be interpreted. An information is different depending on the support it is written on. Moreover the act of writing information on a support suppose the addition of a supplementary information, directly linked to the nature of the support [Bachimont 99]. Our purpose here is to study the supplements introduced by the use of multimedia numeric supports.



Adopting the vision of this process, we must admit that the author can not be aware of what will exactly understand the reader. However, understanding the specificity of the numeric support he could better control the final interpretation and try to bring closer together the information he wants to give and the information effectively read.

Our approach is based on a bibliographic research in order to find criteria adapted to each domain. The first part of this paper present a summary of our results, along with the criteria structure. The second part deals with the description of the applications we are developing using this structured knowledge.

2. CRITERIA

2.1. Six themes

Since our ambition was quite complex, we adopted an iterative approach: Firstly, we began with usability oriented studies, then worked on didactics, and ended with multimedia aspects. Each time our method was to extract criteria from the related literature, test these criteria, integrate them into a prototype, and finally evaluate them in real situation. At each step we could start a new cycle, integrating new aspects we thought relevant. Now we hope to have reached a stable structure dividing the global field into six main themes:

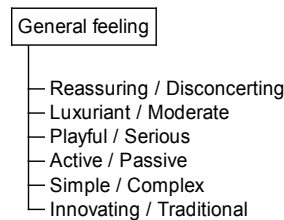
- The "**general feeling**" theme takes into account what image the software offers to the users.
- The "**technical quality**" theme allows the evaluation of the technical realisation of the software.
- The "**usability**" theme corresponds to the ergonomics of the interface.
- The "**multimedia documents**" theme (text, sound, image) enables the evaluation of the contents presentation.
- The "**scenario**" theme deals with the writing techniques used in order to design information.
- The "**pedagogy**" theme finally inspects the pedagogical resources mobilised in the learning context.

For each of these themes we selected and structured a set of criteria and sub-criteria, as described below.

2.2. General feeling

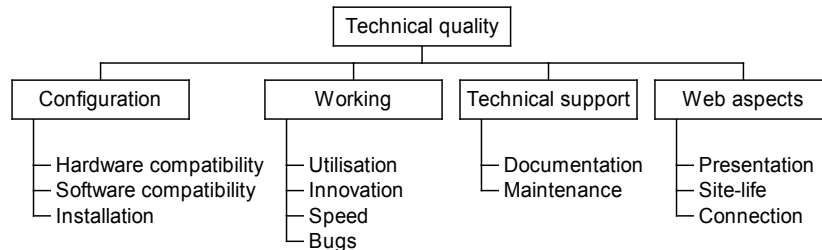
Several experiences we made drove us to the idea that software provides a general feeling to the users. This feeling is issued of graphical choices, music, typographic, scenario structure,... The important fact is that these feelings the user feels deeply affect the way he learns. Our experiences revealed that the general feeling was mainly instinctive, easily describable by the users, quite homogeneous inside a large population, and deeply remaining with time.

In order to better understand this phenomenon we studied various fields, such as visual perception theories [Gibson 79], image semantic [Cossette 82], musicology [Chion 94], cinematography strategies [Vanoie, Goliot-Lété 92],... With these theories and the practical experiences we drove, we managed to submit a list of six pairs of criteria. They make it possible to describe quite satisfyingly what one feel in situation of use of learning software.



2.3. Technical quality

Good software is first of all working software. So we decided to begin with giving the technical criteria software has to satisfy. When one uses slow, hard to configure or bugged software, the reject is generally obvious. Literature, in software design, abundantly deals with these aspects, we submit here one proposition of criteria organisation.



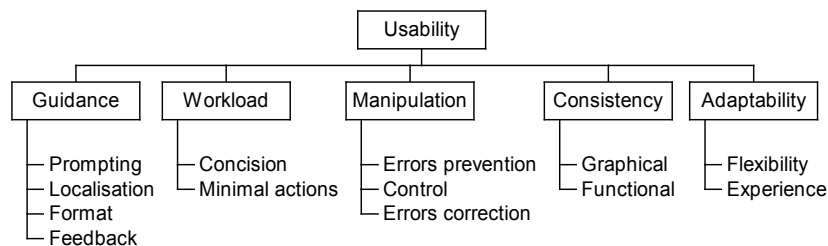
Definitions

- Configuration: Management of software integration in hardware.
- Working: Quality of program running.
- Technical support: Set of means the user gets for the technical use of the piece of software.

- Web aspects: Technical particularities linked to the use of Internet inside the piece of software.

2.4. Usability

A large set of criteria exists in the field of usability of user interfaces. In our context, our problem was to find a compromise between general criteria [Ravden & al 89] and too precise rules [Vanderdonckt 94]. To build the following set, we used in depth the INRIA works [Bastien, Scapin 94], adapting their criteria to our multimedia and educational context.



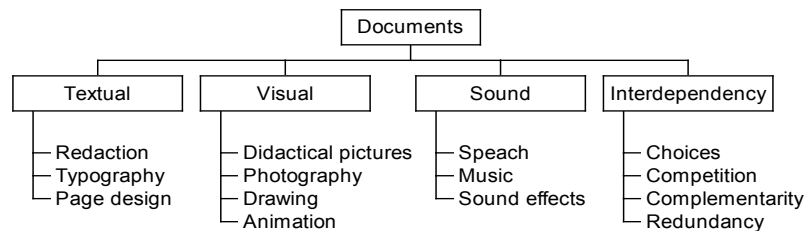
Definitions

- Guidance: Means available to advise, orient, inform, instruct, and guide the users throughout their interactions with a computer.
- Workload: Interface elements that play a role in the reduction of the users' perceptual and cognitive load.
- Manipulation: Control users have on the processing of their actions by the system, and means to detect and prevent manipulation errors.
- Consistency: Way the interface choices are maintained in similar contexts.
- Adaptability: All means available to behave contextually and according to the users' needs and preferences.

2.5. Multimedia documents

Texts, images and sounds are the constituents of the learning software. They have to be taken into account for the information they carry. However the way they are presented is also an important point, since it will influence the way they are read. To build this part of the ques-

tionnaire, we had to explore various domains, as the semantics of images [Baticle 85], the textual theories [Goody 79], the didactical images works [Costa, Moles 91], the photography [Alekan 84], the audio-visual [Sorlin 92],... Our works also point out that in a multimedia environment each document is always presented along with other documents at the same time. The set of documents presented together generates a web of relations that influences the global signification. These interdependencies between documents are as important as each separate document's characteristics, in the process of interpretation.

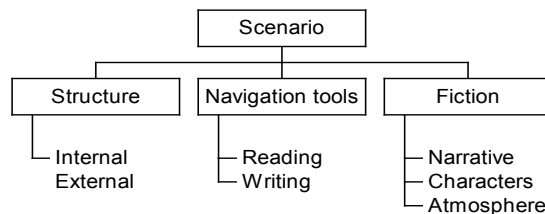


Definition

- Textual documents: Documents based on written text.
- Visual documents: Documents based on pictures and graphs, fixed or animated.
- Sound documents: Documents based on oral text and any other hearing solicitation.
- Interdependency: Set of relationships that exist between these documents in a multimedia environment.

2.6. Scenario

We define the scenario such as the particular process of designing documents in order to prepare the act of reading. The scenario does not deal directly with information, but with the way they are structured. This suppose a original way of writing, dealing with non-linear structure, dynamic data, multimedia documents,... Our studies are oriented toward the various classification of navigation structures [Durand & al 97] [Pognant, Scholl 97], and the fiction integration in learning software [Pajon, Polloni 97].

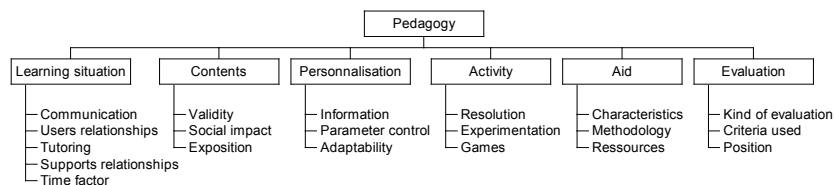


Definition

- Structure: Hyperdocument organisation and set of links between the documents that compose it.
- Navigation tools: Set of means provided to the user in order to help him in the appropriation process.
- Fiction: Integration of an imaginary and not directly link with the subject dimension in the way the documents are presented.

2.7. Pedagogy

Literature offers plenty of criteria and recommendations for the pedagogical application of computer technology, for instance [Dessus, Marquet 91], [Marton 94], [MEDA 90], [Park & al 93]. We also used more specific studies, such as works on interaction process [Vivet 96], or practical experiences [Perrin, Bonnaire 98]. This last theme is expected to describe the specific didactical strategy of the software. Our goal is not impose such or such strategy, stating it is the better one. This normalising approach can not be applied (whereas it was possible for usability or technical aspects), for two main reasons: We do not have enough experience with learning software to impose a way of doing things and the definition of a didactical strategy is totally context-dependent. That means that our criteria only provide a main grid to have a systematic approach in determining what is relevant in one particular case.



Definition

- Learning situation: Description of human and material device in which the software is to be used.
- Contents: Relative to the information provided by the software.
- Personnalisation: Adaptation of the training to the user in order to have it more efficient.
- Activity: Diversity and the quality of the provided activities.
- Aid: Set of means the user gets to help him in his learning process.
- Evaluation: Set of means available to estimate the level and skills of the users.

3. APPLICATIONS

3.1. Evaluation and design

This research gives us a set of principles to take into account in order to deal with pedagogical multimedia documents. We have identified two problems in the introduction: The first one is the difficulty for users to choose a product: How to discriminate poor contents hidden behind an attractive interface? On the other hand, how to feel in front of good pedagogical software, but which is hard to use? How to find the most adapted software for a requested situation? Does the learning software really use the potentiality of multimedia technology? The second aspect is oriented toward the designers, in order to submit them a set of rules to refer in the development process. For instance, our criteria make it possible to give recommendations for text typography, scenario choices or ergonomic rules to strictly follow.

To reach our goals we structured the criteria in a database (Figure 1). In order to whether evaluate or design, we associated additional information to the criteria base: questions and rules. Answering the

questions help in underlining the qualities and weakness of existing software whereas quoting the rules structure the design process.

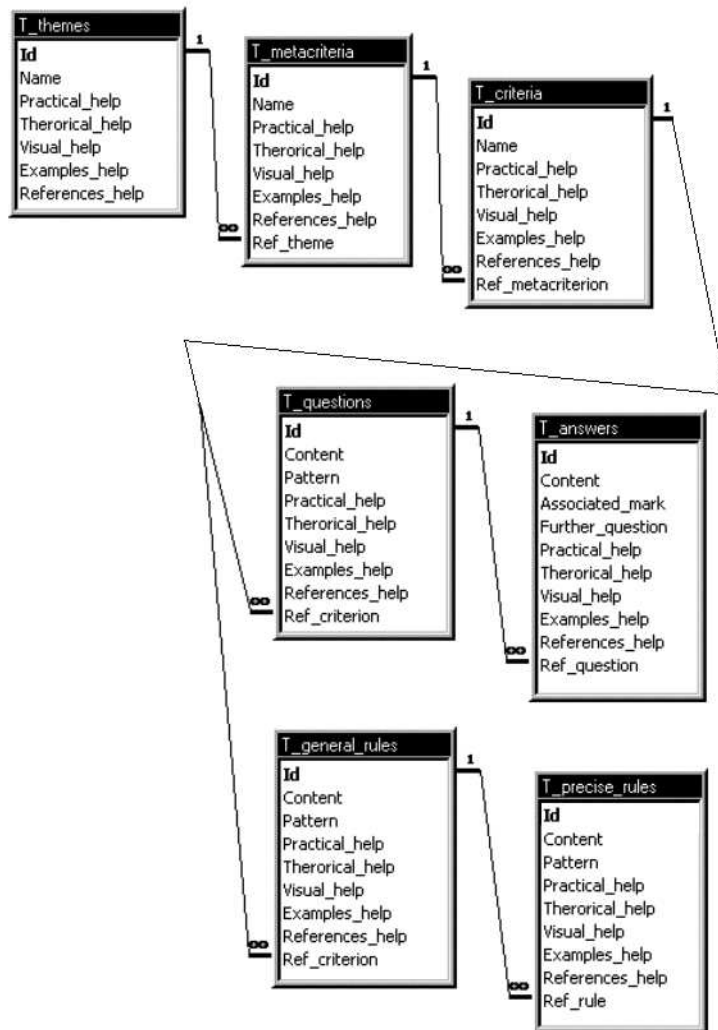


Figure 1: Criteria database structure (simplified representation)

We then developed interfaces to enable the use of the database. At the moment we have a pretty finalised version of the evaluation software (Figure 2), called EMPI (Evaluation of Multimedia Pedagogical Software). We are still working on the prototype of the guidelines version, and till now we just used paper version of database extractions.

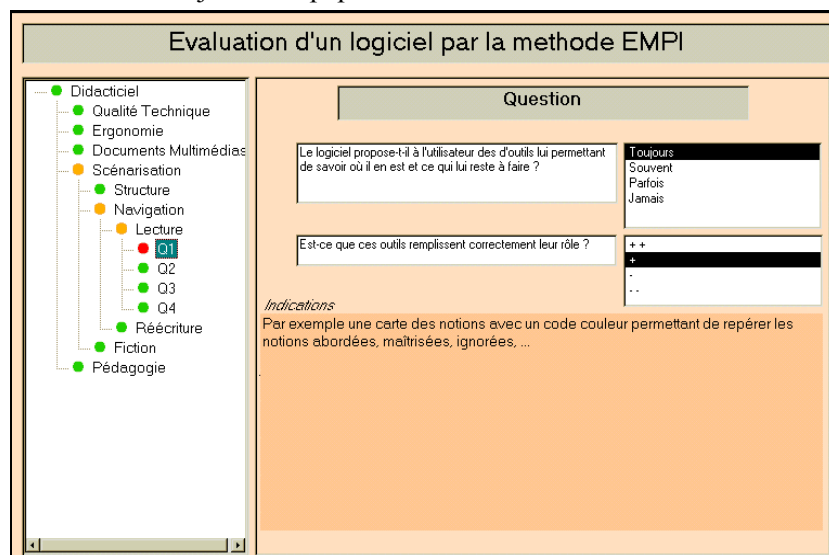


Figure 2: Interface for evaluation (example of question)

Software we develop to exploit the database use basic principles we established through our experiences:

The variable depth: The methods are progressive and allow navigating between the different criteria. At the higher level, we find the themes, and at the lower the questions or rules. The user can work with the precision he wants, deepening or not each aspect, depending on his skills and objectives.

Contextual help: A structured help is provided for each criterion, question or rule, in order to define the words we use, give examples,

suggest practical applications of our concepts, provide theoretical references to deepen each part ,...

Weighting: Since each case of utilisation of the base is specific, we allow and guide users in determining what is more important in their own context. They can state if the rules are to follow absolutely or just to be cared, if an evaluation point is essential or standard.

Strictness: Whereas for technical or usability points we can give strict rules to apply, didactic or scenario aspects are more context-dependent. So we manage the difference between strict rules and simple recommendations.

3.2. Validation program

The methods we presented were and are still tested in situation. The evaluation part already benefits from a large set of validations. Local experiences concerned about ten evaluators using thirty software. Two wider experiences involved about fifty evaluators using the same piece of software. The comparison between the results permits to point out the weak and strong aspects of the questionnaire. A deeper exploitation of the last results is being made in order to finalise a commercial version for the end of the year.

Although the design part is not yet finished, we are testing a paper version of a set of recommendations used in a project for the realisation of a multimedia application to teach basics of algorithmic. It is still early to point out conclusions, however we can already remark that the criteria are useful as a checklist to verify that every important point has been taken into account.

4. CONCLUSION AND PERSPECTIVES

The experience in the domain of multimedia instructional software remains quite weak. Nevertheless we intend to participate in elaborating basic knowledge about it. The criteria we submitted and organised can be useful as a starting point for deeper research, in the purpose of better understanding of their specificity. It is also a starting point for

realising applications that could be of great use in the actual context of skyrocketing developments and uses of multimedia products.

Since the evaluation method is pretty operate, we work on finalising a first version of the designing tool. We are also working on complementary tools, to assist in specifying the requirements for a development project, organising the way software will be articulated within a determined pedagogical device, writing multimedia structured documents,... Our long-term objective is to integrate all these tools in a unique method that could follow the process from the requirements' specification to the final evaluation of the product.

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