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## SET OF CRITERIA FOR EVALUATION AND DESIGN OF MULTIMEDIA APPLICATIONS IN INSTRUCTIONAL CONTEXT

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Making multimedia software implies knowing how to write multimedia documents. Our works is oriented toward the research of relevant literature that could help understanding what multimedia means. We specifically study multimedia software used in an educational context. We particularly focus on finding relevant criteria that describe several domains of textual, visual and sound documents, trying to underline their specificity.

This paper presents a summary of the criteria we organised, along with the description of two methods we develop to apply them: The first one is a method to assist in evaluating multimedia interactive pedagogical software and the second one is a method to help designing such applications.

### Introduction

We can detect an increasing infatuation in institutions and families with the use of new technologies and multimedia, especially in an educational context. Two main problems appear: 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, so we do not have equivalent rules to the ones that exist in the classical domain of edition. However our research intends to help 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 [1][2]. Our purpose here is to study the supplements introduced by the use of multimedia numeric supports.



Adopting this vision on the support, we must admit that the author can not be aware of what will exactly understand the reader. Even so, understanding the specificity of

the multimedia he could better control the final interpretation and try to bring closer together the information he wants to give and the information effectively read.

We adopted the traditional separation between textual, visual and sound documents. 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, with several examples of the criteria we met and selected. The second part deals with the description of the results obtained through two applications of these criteria: A method to assist in evaluating multimedia pedagogical software and a method to help designing such software. The experiences driven through these applications made it possible to validate and adapt our criteria

## 1 Criteria

### 1.1 Textual documents

#### 1.1.1 Framework

Discovery of writing enabled to represent information in a spatial way (the surface) instead of a temporal one, like in oral tradition [3]. This new way of representing allowed building new kind of knowledge. Text is particularly adapted to deal with complex information that can be synthesised on spatial representations (lists, tables, ...) and can be re-examined several times.

Using text in instructional software is pretty bad adapted. The visual concentration imposed by reading on a vertical support, static and luminous, is especially difficult. The size and the shape of the screen also disturb the global visualisation of a set of visual elements. Nevertheless, as we can not replace textual documents by sounds or pictures, we have to deal with it, taking into account the specific conditions of **visibility** and **readability**.

#### 1.1.2 Modern edition domain

The first field we studied was classical edition in paper industry. "A written communication depends as much on the information than on the way it is presented", translated from [4]. We think that this assertion is also totally right for texts to be visualised on screens. So we tried to adapt the principles known for typography and page design within our context. Using literature references such as [5], we gathered the following criteria:

- **Uniformity** ensures homogeneity and trust for the reader.
- **Contrast** gives dynamic effect, and help to maintain attention.
- **Density** of the page should not be too high, especially for screen presentation of the text.
- The design of the page should be discreet and **moderated**.
- The design has to represent the **logic** of the text and give repairs for reading.

- The composition of the page should present a global **harmony**.
- Elements of composition like fonts or position on the page have a proper **semantic** that should guide choices.
- Each **detail** is important.

### 1.1.3 Drafting

Such as reading on a screen is different from reading on the paper, a new way of drafting is to be invented. Currently too many texts are direct transposition from other supports, like scholar books. Classical rules, like quality of language (spelling and grammar), are still relevant. As in every case of communication, the language register (business, technique, academic, cultural,...) is to be adapted to the goal and the reader. But the special conditions of visibility and readability introduce new aspects to take into account, especially articulated around the simplification of the writing [6]:

- Texts should be shorts (blocs of less than 25 lines of 50 characters and sentences less than 15 words.
- Syntax should be usual (avoiding long and complex structures, sophisticated techniques, cross-references,...)
- Vocabulary should be simple and adapted to the readers (avoiding unusual words, neologisms, long words, old-fashion words, vague words,...)
- The articulation of the text should be obvious, structured and logic.
- It is important to begin with the essential part of the communication (tiredness often drives the reader not to finish the texts he begins to read)

## 1.2 *Visual documents*

### 1.2.1 Framework

Like oral verbal communication, visual one has a proper rhetoric. Whereas verbal one is based on a linear way of thinking (A, then B, then C,...) picture is associated to a surface way of thinking [7]. Elements of visual rhetoric are for instance heat, colour, sensuality, fascination, reject, attraction, repulsion, valorisation,... We gather these elements in two notions, central in our case: **iconicity** (measure of abstraction proposed by Abraham Moles) and **attractiveness** (subjective appreciation of the interest of the reader for the picture).

### 1.2.2 Picture semantic

We refer to several codes in order to give a sense to a picture. These codes can be connotative (red implies violence) or denotative (red implies Coca-Cola). Umberto Eco and Christian Metz submit relevant codes, like the chromatic code, the morphologic code the stylistic code, the topologic code, the perspective code, the support code. Referring to signification associated to codes or using stereotypes

does not mean that general and non-contextual rules to follow exist. Originality remains an essential element in order to use codes discreetly [8].

### 1.2.3 Photography

In our society photography is associated with the real world, with a model of truth and objectivity [9]. But this idea is wrong, and like in front of any picture, the reader has to make an effort of interpretation. There is no equality between the reality and a picture of the reality. A picture is the result of selections, choices, done by the photograph [10]. Photography domain generally uses the following criteria:

- **Light** is traditionally linked with the mystic opposition between black and white [11]. The purpose of photography is not to reproduce light, but to use it to underline things [12].
- The **frame** defines organisation and equilibrium of the space and objects. He should guide the vision on important elements.
- **Colours** give global dimension to the photograph and permits to attract the eye on individual details.
- **Granularity** is a mark of quality, especially in the numeric domain where high-definition of pictures needs high use of computer resources.
- The **position** and **angle** of the camera also carries signification, especially in the case of characters.

### 1.2.4 Cinematography

Cinematography inherits the photography parameters adding what is specific to the movement. We generally opt for expressive movements, but without disturbing the visualisation of the pictures [13]. The rhythm, linked to plans, sequences and editing, is also an important parameter of moving pictures.

The special case of very short movies (like for advertisement) is interesting in our case, because today's possibilities of integration of long video into numeric support are quite limited. The directors in this case take care of transmitting a simple, stereotyped, strong, message [14]. They adopt three main strategies, and even if the advertising objective is quite different from pedagogic objectives, we think we can be inspired by their way of doing:

- Argumentation is mainly based on description, explanation or formalisation.
- Narration tries to catch the watcher toward a story, in order to influence him.
- Seduction uses elaborated techniques (fade for instance), attractive music, contrasts and speed to involve the watcher in the communication.

### 1.2.5 Didactic pictures

Realising didactic pictures consists in selecting information to submit a visual representation in order to prepare reading [7]. Examples of didactics pictures are

graphs, charts, tables, maps, ... The realisation of such pictures shall follow some important principles to help understanding:

- The representation shall be simple, and go straight to the essential.
- The picture shall not be ambiguous.
- The didactic pictures shall be coherent between themselves.
- The subject of the communication shall be clear and identifiable.

Abraham Moles also proposes an iconicity degree to describe the level of abstraction of the didactic pictures. This degree, from 12 (the real object) to 0 (formal model) with intermediate values like 9 (a photography) or 5 (a technical drawing), has to be linked to the capacity of the reader to deal with an identified level of abstraction.

### 1.3 *Sound documents*

#### 1.3.1 Framework

Oral communication is temporal so listening has to be simultaneous with speech. It is also based on a fundamentally personal and subjective relationship between human beings. Oral transmission has been modified by the analogic recording, which allows to listen several times the same speech. Numeric recording allows a better manipulation of the information, accessing a precise point of the oral information. It also permits transformation of the sound in order to upgrade it, correct it, modify it or even totally transform it. We say in the case of numeric sound that we do not listen to *what is said*, nor to *what has been said*, but to *what has been said and then transformed*. In spite of this important difference with classical sound, numeric sound conserves a **personal** and **ephemeral** character, which implies a specific way of transmitting information.

#### 1.3.2 Audio-visual

There are three kinds of sounds in cinematography, speech, sound effects and music. Their roles are quite clearly identified in this context [12]:

- Speech drives the story.
- Sound effects reinforce objects and characters.
- Music creates an atmosphere.

To transmit information with sounds, one need, like for picture, to focalise the attention of the listener [15] :

- The localisation principle: One shall know where the sound comes from.
- The individualisation principal: The main sound shall be detached from the other ones.
- The intelligibility principle: The sound shall be audible and intelligible.

### 1.3.3 Musicology

We paid mostly attention to the music, often used in multimedia production. Musicology studies this domain and teaches us that music is the best way to take advantage of the empathic character of the sound [16][17]. This specificity certainly comes from repetition, regularity, and automatism that we find systematically in any kind of music [18]. It implies that music is especially capable of generating emotions to the listener, implying him in a particular ambience. It also helps in memorising.

## 1.4 *Media and multi*

### 1.4.1 Relations

We have just exposed proper characteristics of each kind of document, trying to find relevant criteria in order to specify them. But a fundamental aspect has been voluntarily ignored until now. A multimedia environment implies that a 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 relations are as important as each separate document's characteristics, in the process of interpretation.

Sense of information supported by multimedia documents depends on the supplements brought by each *media*, but also on the supplements brought by the *multi* aspect. Taking this into account marks the evolution from multimedia (where documents are only juxtaposed) to polymedia (where they are integrated into a coherent whole) [19].

We distinguish between two main kinds of relations, the redundancy and the complementarity. For instance when one can visualise a text and at the same time listen to the text read by somebody, we speak about redundancy. But if one can read a text on the history of a country, and at the same time visualise a geographic map of the same country, we speak about complementarity. These two kinds of relations should not be separated, but integrated in the best combination in order to generate symbiosis.

### 1.4.2 Element of choice

The approach we submit implies to choose between different combinations of documents in order to find the best way of transmitting the information. The choices are also fundamental not to present too many documents, risking cognitive surcharge for the reader. We distinguish three main categories of choices:

- Adequation choices: They deal with the mode of the communication (sounds help pointing, pictures help showing, texts help explaining).
- Equilibrium choices: They deal with the over or under utilisation of a kind of document.

- Semantic choices: They deal with the connotations directly linked with the kind of document.

## 2 Applications

This research gives us a set of principles to take into account in order to deal with multimedia documents. We used it to realise two methods, to assist in evaluating and designing multimedia instructional software.

### 2.1 Evaluation

#### 2.1.1 General description

One of the problems linked to the introduction of instructional software is the difficulty of choice of a product, and more widely the problem of evaluation: 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? To answer these questions, we need tools to characterise and evaluate the multimedia learning software. The one we submit is a helping method for the Evaluation of Multimedia, Pedagogical and Interactive software (EMPI).

We oriented our researches towards several areas: computer sciences, ergonomics and multimedia at first, and then we also look through other areas linked to cognitive sciences, social sciences, artistic sciences,... Faced with the complexity of such ambitions, 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. After each evaluation we could start a new cycle, integrating new aspects we thought relevant. At each step the initial method and the previous criteria were also changed, in order to introduce new studies' constraints and ideas.

Now we hope to have reached a stable structure dividing the global evaluation into six main themes:

- The **general feeling** takes into account what image the software offers to the users.
- The computer science **quality** allows the evaluation of the technical realisation of the software.
- The **usability** corresponds to the ergonomics of the interface.
- The **multimedia documents** (text, sound, image) permit the evaluation of the contents presentation.
- The **scenario** deals with the writing techniques used in order to design information.



- The **didactic** module finally inspects the pedagogical resources mobilised in the learning context.

These themes are sub-divided in criteria, sub-criteria and questions. The whole constitutes a variable-depth questionnaire. An associated structured and contextual help describes each element of the questionnaire. The evaluation consists in answering the questions and marking the criteria. More precise description of the questionnaire contents and of the method's general principles has already been described in previous papers [20][21][22].

### 2.1.2 Multimedia documents theme

The multimedia documents part was realised using the research we previously described. To illustrate this application we shall give the complete organisation of criteria we submit to evaluate this theme (Figure 1), along with some examples of associated questions (Figure 2).

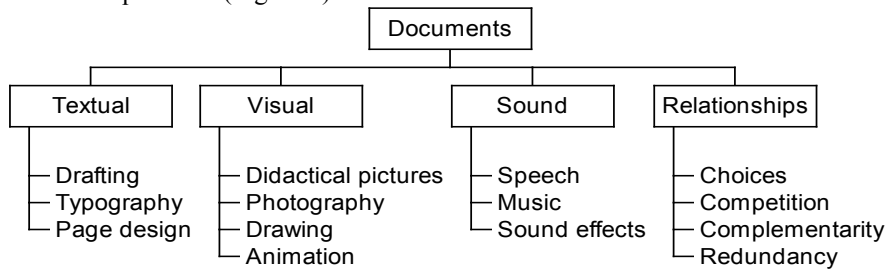


Figure 1 : Criteria of multimedia documents theme

<b>Textual documents / Drafting</b>
What level of language is used in the texts? <i>Simple / Usual / Specific / Complex</i>
Is drafting language reader friendly and are the texts easily understandable? <i>Always / Often / Sometimes / Never</i>
Is the vocabulary familiar to the user? <i>Always / Often / Sometimes / Never</i>
Are there any mistakes in the texts? <i>Never / Sometimes / Often</i>
Are codes or abbreviations used? <i>Never / Sometimes / Often</i>
<b>Visual documents / Photographs</b>
What is the quality of photographs and videos used? <i>High resolution / Medium resolution / Low resolution</i>

What part of the screen is available to visualise pictures? <i>Full screen / Half screen / Smaller</i>
Do colours, lights and contrasts underline what is important? <i>Always / Often / Sometimes / Never</i>
<b>Sound documents / Speech</b>
Are speeches perfectly intelligible? <i>Always / Often / Sometimes / Never</i>
Characterise speech rhythm: <i>Normal / Too slow / Too quick</i>
Are the voices pleasant to listen to (i.e. tone and key)? <i>Always / Often / Sometimes / Never</i>
Are the social and cultural characteristics (accent, sex) of voices relevant? <i>Always / Often / Sometimes / Never</i>

Figure 2 : Example of evaluating questions for multimedia documents theme

## 2.2 Design

### 2.2.1 Description

Usability domain provides sets of rules that help software designers to realise human-machine interfaces [23]. We intend to adapt this approach in order to submit design recommendations for writing of multimedia documents. Whereas the evaluation method is well developed and applied, the design method is still in a prototyping phase. Nevertheless we already have too main tools: One that provides rules to apply (example Figure 3) and one that help making choices, related to a specific context, by giving indications (example Figure 4).

Text blocs should be left aligned (best readability) or justified (best uniformity), but not right-aligned nor centred.
Titles should be well separated from the text, as short as possible, correctly positioned and give information on the text that it refers to.
Fonts should not be numerous. We advice two, one with serif and one without.
Size of characters should be proportional with importance of the message.
Styles should not be too much used. We advice bold for titles, italic for special words and avoiding the other one.
Background colour should be bright and text colour should be dark. We advice black text on green background and blue text on white background.
First information of the page should be in the upper left corner, and last one in the lower right corner. Note that left part of the screen is generally more watched

Figure 3: Example of rules for typography

<b>Red</b>	<b>Yellow</b>	<b>Green</b>	<b>Blue</b>	<b>Black</b>	<b>White</b>
Violence	Jalousy	Hope	Meditation	Sadness	Purity
Anger	Reason	Calm	Innocence	Death	Delight
Life	Happiness	Bad	Infinite	Darkness	Wedding
Power	Spirituality	Patience	Purity	Mystery	Sobriety
Action	Perception	Anxiety	Space	Evil	Innocence
Love	Stimulation	Equilibrium	Fresh	Mourning	Virtue
Murder	Magic	Rest	Wisdom	Rest	Chastity
Heat	Dynamism	Truth	Science	Depth	Cleanness

Figure 4: Example of indication for color associations

### 2.3 Validation program

The two methods we presented were and are still tested in situation. The evaluation method already benefits from a large set of validations. We implemented it in a software version in order to make it really effective. 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. The last experience enables us to think that multimedia criteria we used were reasonably relevant. A deeper exploitation of the results is being made in order to present precise conclusions.

The conception method is not finished yet, we are ending a piece of software that could handle the rules, recommendations and indications. Nevertheless 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, but we can already remark that the criteria are useful as a checklist to verify that every important point has been taken into account.

### Conclusion and perspectives

The experience in the multimedia domain remains quite weak. Nevertheless we intend to participate in elaborating the bases of knowledge about how to do multimedia. The criteria we proposed and organised can be useful as a starting point for deeper research, in the purpose of better understanding of the multimedia specificity. It is also a starting point for realising applications that could be of great use in the actual context of skyrocketing developments 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 a tool that help specifying the requirements for a multimedia instructional application. Our long-term objective is

to integrate all the tools we have in a unique method that could follow the process from the requirements' specification to the final evaluation of the product.

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